

MINING engineering

JULY 1959



SME Membership Number ➤



Wilfley's "Quick-Change"

FEATURES

Cut DOWNTIME... MAINTENANCE COSTS

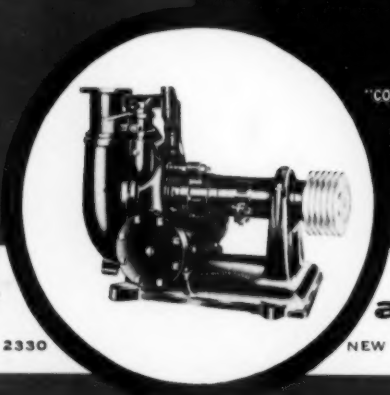
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Wilfley parts can be changed in a matter of minutes — and without disturbing the intake or discharge piping. This "quick-change" — another Wilfley exclusive — is an important cost-saving advantage to economy-minded plant operators.

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To give you maximum economy in solids pumping every Wilfley installation is
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WILFLEY SAND PUMPS

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DENVER, COLORADO, U. S. A. P.O. BOX 2330

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COMING EVENTS

- July 9-18, Mining Machinery Exhibition, Grand Hall, Olympia, London, England.
- July 13-17, Western Resources Conference, sponsored by University of Colorado, Colorado State University, Colorado School of Mines, New Chemistry Bldg., University of Colorado Campus, Boulder, Colo.
- July 15-17, International Symposium on Shaft Sinking and Tunneling, sponsored by Inst. of Mining Engineers, Apex Conference Hall, Olympia, London, England.
- July 25, AIME Adirondack Section, field trip to New York Seaway and Federal Power Authority, Massena, N. Y.
- Aug. 10-17, annual conference, Australasian Inst. of Mining and Metallurgy, Melbourne, Victoria, Australia.
- Aug. 15, AIME Knoxville Area Subsection, Southeast Section, annual picnic.
- Aug. 29, AIME Adirondack Section, field trip to Canadian Titanium Pigment Co., Val-d'Or, Quebec, Canada; trip with wives, headquarters at Montreal.
- Sept. 8, AIME Morenci Subsection, Arizona Section, Longfellow Inn, Morenci, Ariz.
- Sept. 13-18, SME Minerals Beneficiation Division, American Chemical Soc. Colloid Chemistry Section, joint meeting on "Solid-Liquid Interphases," Atlantic City, N. J.
- Sept. 14-17, American Mining Congress, Metal Mining & Industrial Minerals Convention, Denver.
- Sept. 24-26, SME Industrial Minerals and Coal Divisions, joint meeting, Bedford Springs, Pa.
- Sept. 25, 26, AIME Southeast Section, annual fall meeting, Riverside Hotel, Gatlinburg, Tenn.
- Sept. 26, AIME Adirondack Section, field trip to Ruberoid Co. asbestos operation, Hyde Park, Vt.
- October, AIME Adirondack Section, field trip and football game, vicinity Syracuse, N. Y.
- October, AIME Lehigh Valley Section, technical meeting.
- Oct. 7-10, Rocky Mountain Assn. of Geologists, 11th annual field conference on Cretaceous sedimentary section in Colorado and adjacent areas; for further information, contact the association, Denver.
- Oct. 8-10, Exploration Drilling Symposium, tri-sponsors: Colorado School of Mines, Pennsylvania State University, and University of Minnesota; Pennsylvania State University, University Park, Pa.
- Oct. 12-14, 8th National Clay Conference, sponsored by Clay Minerals Committee, National Academy of Science—National Research Council, University of Oklahoma, Norman, Okla.
- Oct. 19-21, Congress, Mining Section, National Safety Council, Congress Hotel, Chicago.
- Oct. 27-29, 1959 AIME-ASME Joint Solid Fuels Conference, Netherland-Hilton Hotel, Cincinnati.
- Nov. 9-12, Society of Exploration Geophysicists, annual meeting, Biltmore Hotel, Los Angeles.
- Dec. 4, AIME Lehigh Valley Section, ladies' night.
- Dec. 5, AIME Knoxville Area Subsection, Southeast Section, annual Christmas Party, C'est Bon Restaurant, Knoxville, Tenn.
- Dec. 6, 7, AIME Arizona Section, annual meeting, Speaker: J. L. Giltson; Tucson, Ariz.
- Feb. 14-18, 1960, AIME Annual Meeting, Hotel Statler, New York.
- Feb. 16-19, Australasian Inst. of Mining and Metallurgy, Symposium on Hydrometallurgy, "Wet Processing of Minerals and Industrial Products," Adelaide, Australia.
- MAY 9-11, American Mining Congress, Coal Convention, Pittsburgh.
- July 11-18, 2nd World Conference on Earthquake Engineering, organized by Science Council of Japan in cooperation with Japan Soc. of Civil Engineers, Architectural Inst. of Japan, Seismological Soc. of Japan; Tokyo and Kyoto, Japan.



MINING engineering

Vol. 11 NO. 7

JULY 1959

COVER The Directory issue registers mining members around the world. To picture this steadily growing membership, artist Herb McClure symbolizes the far-flung SME membership around the globe. The SME Membership Directory in two sections, alphabetical and geographical, follows page 752.

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- 686 Trends in the Application of Geophysics • W. E. Heinrichs, Jr.
- 691 Designing for Tailing Disposal in the Southwest • E. V. Given
- 694 Differential Thermal Analysis for Ore Treatment Study
• W. I. Watson
- 697 The Gem Stocks and Adjacent Orebodies, Coeur d'Alene District, Idaho • G. M. Crosby
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• W. C. Overstreet, P. K. Theobald, Jr., and J. W. Whitlow
- 715 Laboratory Investigation—Flocculation to Improve Coal Slurry Filtration • M. R. Geer, P. S. Jacobsen, and H. F. Yancey
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1959 SME Membership Directory has been bound into the July issue of MINING ENGINEERING, following page 752.

MINING ENGINEERING Staff, Society of Mining Engineers, and AIME Officers are listed on the Drift page.

Address insertion orders and copy to MINING ENGINEERING, 29 W. 39th St., New York 18, N. Y. Send plates to: MINING ENGINEERING, c/o Lew A. Cummings Co. Inc., 215 Canal St., Manchester, N. H. Published monthly by the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., 29 W. 39th St., New York 18, N. Y. Telephone: Pennsylvania 6-9220; TWX NY 1-1304. Subscription \$8 per year for non-AIME members in the U. S., & North, South, & Central America; \$10 foreign; \$6 for AIME members, or \$4 additional for members only in combination with a subscription to "Journal of Metals" or "Journal of Petroleum Technology". Single copies, \$.75; single copies foreign, \$1.00; special issues, \$1.50. AIME is not responsible for any statement made or opinion expressed in its publications. Copyright 1959 by the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. Registered cable address, AIME, New York. Indexed in Engineering Index, Industrial Arts Index, and by National Research Bureau. Second class postage paid at New York, N. Y., and at Manchester, N. H. Number of copies printed of this issue 14,800.

AIR SURVEYS SPEED MINING EXPLORATION AND DEVELOPMENT

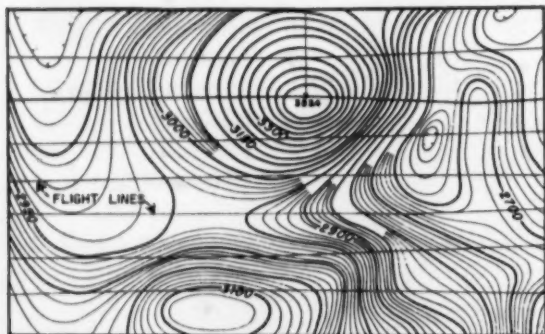
*How new aerial methods
cut costs, save time
from first exploration to
final staking of railroad centerline*

Air surveys are saving time and money in exploration and development of modern mining properties.

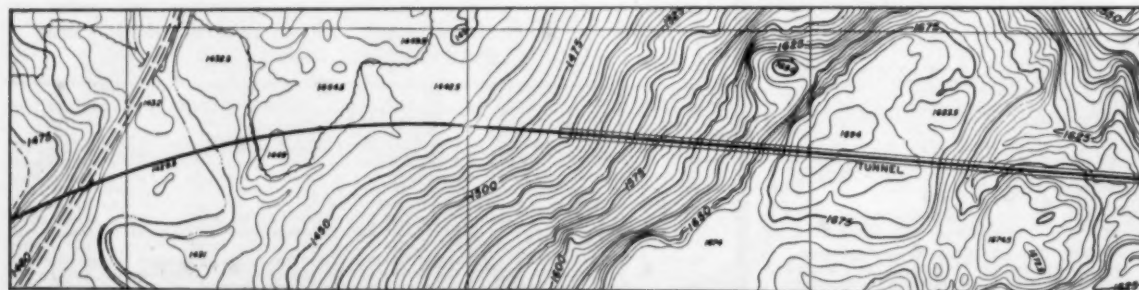
First use comes in the prospecting stage. The most important new aerial exploration tool is the Aero/Newmont electromagnetic detector, used in the search for sulphide ores. It measures both in-phase and out-of-phase EM signals, and a magnetometer record is made at the same time. The correlated information high-grades the ground targets to be studied, says Aero Service Corp., Philadelphia.

Both magnetometer and EM detector are helicopter-borne. This permits tree-top level surveys, following closely the shape of the land, in searches for lead, copper, and zinc.

A more widely used exploration tool is the airborne magnetometer. Since Aero made the world's first mineral survey in 1946, it has flown nearly 3,000,000 miles with the sensitive Gulf instrument.



Magnetic peaks such as these were picked up in air survey over previously unknown iron ore body.



This map—5 ft. contours, 1"=200 ft.—aided final location of Erie Mining's railroad.



Equipped with electromagnetic detector, magnetometer and scintillation counter, this helicopter has been busy on many surveys in the Far North and other Canadian areas.

One survey turned up the now famous Marmora ore body. Another major iron ore find was uncovered in eastern Pennsylvania at a depth of 1,500 to 3,000 ft. Survey cost: 7 cents per acre.

Other surveys include the Allard Lake project in Quebec, to define area of possible ilmenite deposits—and searching for new nickel deposits in Canada. Aero surveys also helped to uncover Quebec Cartier's iron ore deposits in northern Quebec.

Around the world, Aero crews are completing surveys in Thailand, Korea, Laos, Venezuela, Union of South Africa, and the United Kingdom. Doppler radar, newest navigational aid, will be used to guide a new search over South American jungle.

Other air surveys help to plan and locate mining communities. At Elliott Lake, photo interpretation provided information about soils, timber, and potential fill areas. Topographic maps were compiled for engineering planning and construction.

Pre-engineering surveys for Quebec Cartier helped to locate its 192-mile railroad and stake its center line. More, it provided soils studies and topo maps for two town sites, a hydroelectric plant, a harbor and a concentrating plant.

Another railroad project performed by Aero called for final location maps, plus center line staking over 75 miles of swampy, brush-covered terrain. Surveying, mapping and location work were completed in 1½ years for Erie Mining Co.

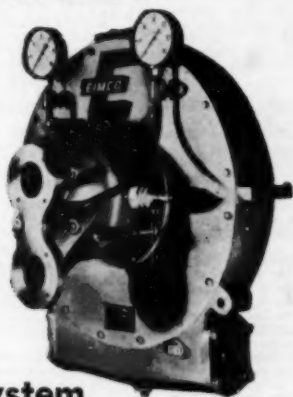
Information about Aero's broad services may be obtained by writing AERO SERVICE CORP., 210 East Courtland St., Philadelphia 20, Pa. Ask for new literature concerning exploration and mapping.

These Twin Features Give You Better Drum Filter Performance . . .



1 HY-FLOW Valve

. . . eliminates vacuum loss

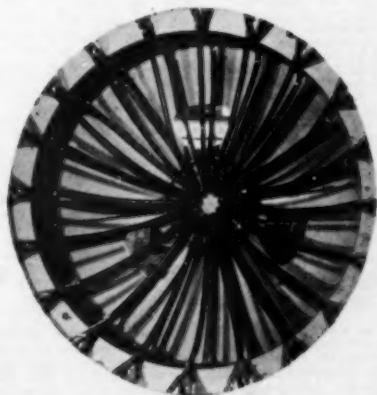


Filtrate flow is always unrestricted with Hy-Flow filter valve, developed by Eimco. This new, streamlined valve entirely eliminates all angular passages which caused troublesome turbulence and vacuum loss on flat type filter valves.

With Hy-Flow valve, drum filters operate more efficiently throughout all zones of the filtration cycle. Operators report greatly improved operating economies.

2 E-VAC System

. . . eliminates moisture in piping



Another major improvement in drum filter design, perfected by Eimco, is the E-Vac system of sweeping moisture from piping with air.

Vacuum to lead and trail pipes from each drum compartment is alternately blocked off as drum revolves. Air drawn through pipes sweeps moisture from piping system and drainage deck. No blow-back of filtrate. Result is a dryer filter cake.

The Eimco representative in your area can give you more facts on Eimco's complete line of filtration or process equipment for liquid-solids separation.

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Research and Development Division, Palatine, Illinois

• Process Engineers, Inc. Division, San Mateo, California

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BRANCHES AND DEALERS IN PRINCIPAL CITIES THROUGHOUT THE WORLD



B-423

PERSONNEL

THESE items are listings of the Engineering Societies Personnel Service Inc. This Service, which cooperates with the national societies of Civil; Electrical; Mechanical; Mining, Metallurgical, and Petroleum Engineers, is available to all engineers, members and non-members, and is operated on a nonprofit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 pct of the first year's salary if a nonmember, or 4 pct if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number. When making application for a position, include \$2 in stamps for forwarding application to the employer and for returning when possible. A weekly bulletin of engineering positions open is available at a subscription rate of \$3.50 per quarter or \$12 per annum for members, \$4.50 per quarter or \$14 per annum for nonmembers, payable in advance. Local offices of the Personnel Service are at 8 W. 40th St., New York 18; 57 Post St., San Francisco; 29 E. Madison St., Chicago 1.

MEN AVAILABLE

Geologist, Ph.D., age 27. Six field seasons in mining exploration, geological mapping, geochemistry, geophysics, and prospecting, 3 months underground. Location, immaterial. M-483.

Exploration Engineer, B.S. Sc., in mining engineering, age 51. Over ten years in general exploration across pre-Cambrian areas of Canada including property deals, claim staking, gold, base metals and iron, geology, geophysics and diamond drilling; over ten years mine development planning, mine geology, mine and quarry planning, rock breaking and handling. Prefer eastern Canada. M-484.

Explosives Engineer, B.S. in mining engineering, age 54. Registered Professional Engineer. Twenty-five years experience with high explosives permissibles and ammonium nitrate-fuel oil blasting agents in mines, quarries, stripping and construction projects. Broad experience in drilling and blasting methods. M-949-Chicago.

Sales Engineer, B.S. in mining engineering, age 24. Military service will be completed in July 1959. Background in TV production and 2 years management and supervisory experience in the Corps of Engineers. Married. M-948-Chicago.

Manager, Administrative Assistant, Superintendent, B.S. in mining engineering, age 30. Eighteen years varied mining experience, last six and at present in top management. Energetic, good organizer in establishing new mining operations, strong in personnel, labor, and community relations, financial and cost accounting. Fluent Spanish. Location open. M-485.

Mill Superintendent, Metallurgist—Metal or Non-Metal Production, age 34, Met. E. For eight years was superintendent and foreman

TEACHING POSITION. Mineral exploration and applications of geology to mining operations. Master degree. Commercial experience, 5-10 years. Dean Vernon E. Schied, Mackay School of Mines, University of Nevada, Reno, Nevada.

MINING GEOLOGIST. Master degree. Geologic field investigations and preparation of reports. Director, Vernon E. Schied, Nevada Bureau of Mines, University of Nevada, Reno, Nevada.

in milling uranium, gold, and silver. Spent two years as project engineer making preliminary examinations and evaluation of ores in laboratory and pilot plant. Spent two years in development of rubber products manufacturing. \$650. Prefer San Francisco area. Home is New Mexico. M-1588.

Superintendent—Copper Smelting, age 34, Met. E. Two years spent as general foreman in copper smelter departments. Gained five years experience as testman and in production control in copper smelter. \$12,000. Prefer southwest U.S. or midwest. Home, Arizona. M-1442.

Manager, Superintendent — Mine, Metals, Manufacturing, age 47, Min. E. For one year was consultant, finding, testing, evaluating bauxite for aluminum plant. For six years was general superintendent of aluminum mining and milling. For 12 years was office manager from laborer in every mine and smelting task. For five years worked as superintendent of lime manufacturing, handling construction, and as manager for machinery manufacturing. \$800. Prefer western U. S. Home, California. M-1479.

Manager or Assistant—Mining Development and Operation, age 50, Min. E. For 25 years was general manager, vice president, director, superintendent in underground placer and lode gold mining operations, negotiations, worked in all positions from mucker, timberman, through construction and maintenance. \$1000. Any location. Home, California. M-1457.

Management Supervisor — Mine Operations, age 51. Gained 16 years experience as assistant manager, purchase agent, supervisor of open pit, placer and lode; planned supervised mechanical department, to install and supervise electrical maintenance and power lines substations and pumping equipment for a tungsten mine. Also spent 12 years in open pit mechanical operations in a coal mine and cinnabar ore. \$500 up. Any location. Home, Arizona. M-1170.

Manager, Superintendent—Open Pit or Underground Metals, age 50, Min. E. Spent four years directing underground, stoping for gold mining. For two years directed mining program on open pit nickel mining; location, operations, production control. For six years was in efficiency engineering in copper mining. For ten years was in engineering, production, as core drill inspector on manganese mining. \$7800 up. Any location, M-1372.

Layout, Design—Metal, Chemical Plants, age 30, Min. E. Experienced for one year in design and borax plant equipment installation. Made estimates, costs, dealt with contractors. Spent two years in design and layout work for uranium mills, doing structural, equipment arrangement, field supervision. For four years was surveyor and engineer. Did mapping, exploration, and mine development work, topographic, sampling, in surface and underground for tungsten, phosphate, and military. \$700. Prefer San Francisco area. Home, California. M-1762.

Home Management Studies, Sales—Mine, Mill, Heavy Chemicals, age 40, with two years in economic studies on marketing and operational feasibility, evaluating business potential and forecasting the extent of business for a major engineering consultant and builder. Seven years training in mining company, in industrial engineering, construction supervision, as operating foreman. For nine years worked in mining and heavy industrial machinery, sales, estimates, quotes. \$12,000. Prefer San Francisco area. Home, Peninsula. M-1734.

Miner, Geologist—Underground, Open Pit, age 23, E.M. in geology. Recent graduate with one year's experience in copper, molybdenum, and military; worked as mucker, did contract measurement, drafting, estimates for pit planning, cross sections, calculating overburden and ore tonnage, design draft reinforced concrete beams, columns, and concrete surfacing, as mining trainee. Salary open. Prefer foreign. Home, Arizona. M-1720.

Assistant Chief—Open Pit or Underground, age 26, Min. E. with three years dust control in mine, mill, smelter; designed heating, ventilating, cooling for new copper mine plant building. Spent two years surveying, calculating, drafting for uranium mining and

Industrial Mineral Technologist, Master's degree in Mineral Technology, or equivalent. Conduct lab research and field investigations in industrial mineral preparation and utilization. Teach part time. Mackay School of Mines, University of Nevada, Reno, Nevada.

milling. One half year as miner's helper in zinc, silver, and lead. \$650. Prefer western U. S. or foreign. Home, Arizona. M-1369.

Methods and Industrial Engineer—Non-Metallic Mining and Milling, age 44, geologist. For 14 years senior methods and industrial engineering in mining and milling asbestos and manufacturing into building products; plant layout, material handling, cost reduction, equipment specifications, operational manuals, time study, job evaluation, transportation and loading studies. Nine years in manufacturing building products and insulation board; development of milling and manufacturing operations, superintendent of mill and plant, control of quality, test materials. \$7000 up. Any U. S. location or foreign. Home, Mass. M-1729.

Mining Engineer, B.S. in mining engineering, age 25. Three years experience in mining. Last year intense experience in mine plant design, exploration, market development, etc. Speak Spanish. Location, immaterial. M-486.

General Manager, engineer of mines, age 51. Twenty-seven years executive and administration experience in charge of large mining and milling operations in U. S., South America, and South Africa. Location, immaterial. M-487.

Assistant Superintendent, B.A. in geology, age 33. Seven years as assistant superintendent, assistant manager, mine engineer, geologist in surface and underground mining. Experience in both metallic and non-metallic fields. Good record supervising personnel. Desire affiliation with progressive company. Will travel from one central location. Prefer south or east. M-482.

POSITIONS OPEN

Recent Graduate Mining Engineer, to work as staff assistant to manager of 300 tied operations in northeastern New York. Will be in charge of mine and quarry, mapping, programming and exploration and will spend one half of time processing engineering and quality control. Salary open. W6963.

Research or Production Engineers, Ore Dressing, 6 Engineers needed, B.S. or M.S. with high school grades or outstanding experience as ChE, ME, or Met. E. Will consider applications from recently graduated engineers or engineers with up to six years experience. For a large metallurgical (ore dressing) plant. \$500-\$600 up. S-4143-R.

Process Researching—Non Ferrous Extraction, 3 Engineers needed, Ch.E. or Met. E. plus some additional experience in research in non ferrous extraction metallurgy. Will work on special project to develop improved pilot plant operation and design. Spanish desirable. \$9600. Cuba. S-4163.

Smelter Engineer—Copper, B.S. in metallurgical engineering, mining engineering, or civil engineering, plus a required minimum of at least five years experience in pyrometallurgical industry, preferably in copper smelting, two years of which must have been in a supervisory position. Salary commensurate with experience and ability. Apply by letter in confidence. For a large producing company in South America. S-4048.

District Industrial Engineer—Mining Company, with B.S. or M.S., IE or ME, plus post-graduate studies in production control, tool design, material handling, industrial psychology, etc. Recent practical industrial engineering experience required, with at least two years in supervisory capacity in a fabricating industry; experience as a machinist or tool maker desirable. Salary commensurate with experience and ability. Apply by letter. South America, S-4048.

Junior Engineer—Nonmetallic Mining and Processing, EE or ME, preferably married and not out of college for more than five years. Will participate in management training leading to managerial positions with a large non metallic mining and processing company. Must be adaptable to life in a small mining community. Apply by letter. Salary commensurate with experience. Nevada. S-4208-R.

Mining Engineer, preferably with two to three years mining experience in placer or with prospect churn drilling or gold. Salary, \$4200 a year plus 2½ months salary as bonus and other incentives. Location, South America. F7460.

Engineers, a) Engineer—Mill Superintendent, experienced flotation expert who understands art of processing pegmatite ores by means of flotation reagents. 100 tons of pegmatite ore per 24-hr day mill, 7 days per week. b) Assistant Mill Superintendent, c) Foreman. Personnel should be experienced in pegmatite flotation mill processing. Apply by letter giving complete background and expected salary. Location, Midwest. W7463C.

(Continued on page 654)

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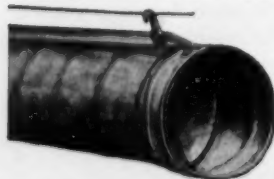
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LETTERS

Dear Mr. Day:

This is in reply to your good letter of April 15 in which you expressed your concern over the decrease in mining engineering enrollment at most schools in the U. S. and in which you asked me how enrollment is holding up at the University of North Dakota.

Enrollment at the University of North Dakota in mining has increased in recent years. I came here in 1954 and the graduating classes since then have been as follows: 1955, 2; 1956, 2; 1957, 3; 1958, 7; 1959, 6. There are many reasons for the decrease in mining engineering enrollment. These are the main ones:

The mining industry has, as always, been the victim of widely fluctuating prices. And mining, especially underground mining, has great difficulty in varying its production in accordance with varying demand. Also, within the last 20 years, the U. S. tax laws have begun to favor strongly the producer whose price (and thus whose production) does not fluctuate.

But even within the context of all its difficulties, the mining industry has not treated its able, young, new engineer as he should have been treated. Most frequently the graduating mining engineer has started to work for less money than the electrical, mechanical, or chemical engineer. He has worked in a location where he would have a hard time finding a wife if he wasn't already married, and where he would have a hard time keeping one if he was. I believe he has received less genuine consideration than have these other kinds of engineers. Our graduating high school students are aware of all this.

The industry has also assigned choice jobs formerly done by mining engineers to engineers and technical people with other specialties. Much exploration is being done by geologists, many of whom are untrained in either mining methods or evaluation, and I would class a knowledge of these two as a prime requisite for exploration thinkers. Mineral dressing is being done by the metallurgist. Efficiency studies are being done by the industrial engineer. That leaves for the mining engineer the job of production mining, and much of his former work is being done

by specialists for higher pay and more prestige.

From the point of view of their education, experience and development, I classify men as either specialists, generalists, or superficialists.

A specialist develops himself deeply in his specialty. Engineers start their careers as specialists.

A generalist is a fellow who develops from depth in a single specialty to depth in a series of related specialties. The mining generalist is the man who has deep insights into geology, exploration, and evaluation, mining methods, ore treatment, primary metallurgy, and his knowledge in each of these is as deep or nearly as deep as the specialist.

The third fellow, the superficialist, skims the surface of knowledge, and he has little to offer that cannot be gotten from the newspapers.

The greatest single sin of U. S. education is that it is failing to create generalists. It is importing them (for example Einstein, Fermi, Bohr, Teller did much of our great work on the nucleus). The mining engineer is the generalist of the mineral industry; the industry has failed to accept him for what he is, and has failed to see that one good generalist is better than several specialists. Industry seeks to hire, as one friend of mine puts it, "not only the specialist, but the narrow damn specialist."

However, I'm sure all this is self-correcting in the long run. Today's poor conditions, and poor pay are the equivalent of low demand for the mining engineer. Low demand is resulting in a low supply of mining engineers, but industry will always need mining engineers and will soon be forced to adjust conditions of employment, pay, and long-run opportunity so that mining engineering will attract more of our high school graduates than it is today. I will welcome that day.

Cordially yours,
Howard L. Waldon
Professor of Mining Engineering
University of North Dakota

Personnel

(Continued from page 652)

Metallurgist or Mining Engineer, graduate with one or two years experience in concentration plants or ore testing laboratories. Prefer single status. Salary, \$4200 to \$4500 year plus board allowance for single men; plus \$75 month board allowance, plus housing with utilities for married man. Location, Central America. F7433.

Mine Superintendent or Assistant Mine Superintendent—Coal: minimum of five years experience as mine foreman or superintendent of highly mechanized coal mine. Salary, open; apply by mail. Southwest. S(P)-4314 (a).

Mine Engineer—Coal: minimum of five years in responsible engineering position involving design, construction, and planning for coal or other mining operation. Salary, open. Apply by letter. Southwest. S(P)-4314 (b).

Smelter Engineer—Copper: B.S., Met. E., M.E., or C.E., plus a required minimum of at least five years experience in pyrometallurgical industry, preferably in copper smelting, two years of which must have been in a supervisory position. Salary, open. South America. S(P)-4048.



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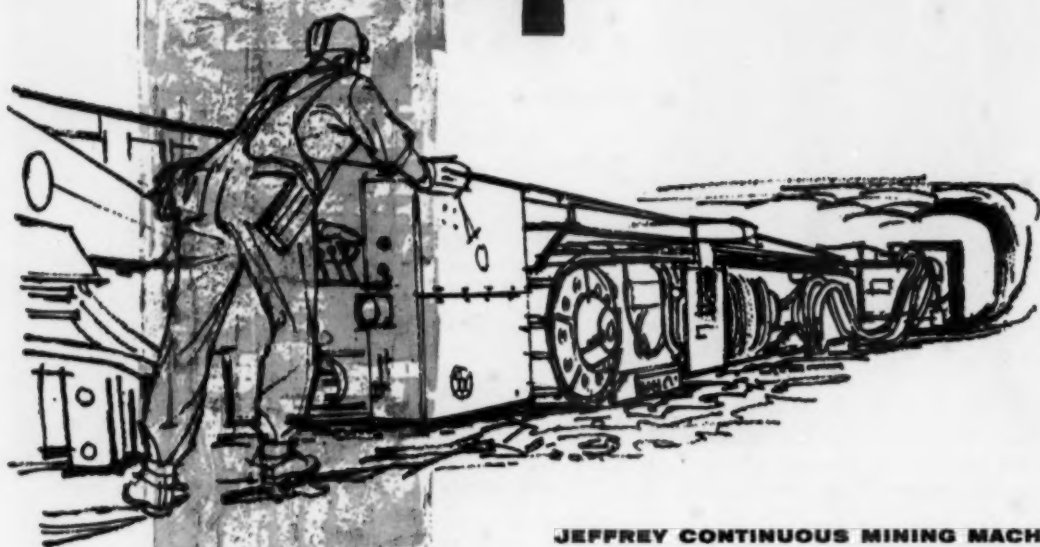
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BOOKS

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Economics For The Mineral Engineer, by Edmund James Pryor, Pergamon Press Inc., 122 E. 55th St., New York 22, N. Y., 254 pp., \$8, 1958—This volume correlates the economics, managerial administration, and technical control of mineral engineering processes. The author, a member of the Faculty of the Imperial College of Science and Technology in London, discusses prospecting, sampling, and valuation; accounts and organization; the managerial structure; mill records and management; new construction and the new plant; and marketing the product. . . .

Engineering Manual, edited by John H. Perry and Robert H. Perry, McGraw-Hill Book Co. Inc., \$9.50, 1959—This collection brings together in one handy volume data and methods used in the architectural, chemical, civil, electrical, mechanical, and nuclear engineering fields. Mathematical tables and physical and chemical data common to all the engineering sciences are presented in sections prefacing the manual, and additional tables, graphs, and formulas are included in the appropriate sections. . . .

Handbook of Industrial Loss Prevention, by the staff of the Factory Mutual Engineering Div., McGraw-Hill Book Co. Inc., \$20, 1959—The fundamental principles, procedures, and reference data for protecting factories and processes against destruction and damage are given. Topics covered are safe construction, automatic sprinkler systems

and water supplies, safeguards for processes involving flammable liquids or gases, elimination and control of ignition sources, anchoring roofs against wind, earthquake protection, and other preventive measures. . . .

Mechanical Engineer's Handbook, edited by Theodore Baumeister, 6th edition, McGraw-Hill Book Co. Inc., \$23.50, 1958—This standard handbook, previously edited by Lionel S. Marks, covers virtually every aspect of mechanical engineering. Theory, standards, and practices are compiled by over 90 people, each a specialist in his own field. Revisions and additions include numerical analysis and computing machines, vibrations, aerodynamics, jet propulsion and atomic power. . . .

Scale-Up In Practice, edited by Richard Fleming, Reinhold Publishing Corp., 134 pp., \$4.50, 1958—A unified review of the various aspects of pilot plant problems. Among the topics discussed are the factors justifying the operation of pilot plants, a review of scale-up theory, and the hazards involved. . . .

An Outline of Photogrammetry, by K. Schwidersky, Pitman Publishing Corp., 2 W. 45th St., New York 36, N. Y., 326 pp., \$13, 1959—Translated from the German, this text gives a reasonably concise presentation of the fundamentals, methods, instruments, and results of photogrammetry from a practical standpoint. . . .

Work Measurement, by Virgil H. Rotroff, Reinhold Publishing Corp., 203 pp., \$4.85, 1959—The need for better planning is stressed in this volume which discusses the setting of work standards and how to use and maintain them. All phases of the work measurement program are presented: why work is measured and what it means to company personnel; the standard data approach; the economics of work measurement; the consultant's role, etc. . . .

Die Metallischen Rohstoffe, by Friedrich Ahlfeld, Ferdinand Enke Verlag, Stuttgart, Germany, 212 pp., approx. \$11.50 (48DM), 1958—This 11th volume in a series on metal resources covers tin and tungsten. Each of the two sections begins with a brief survey of properties, history, occurrence, origin, mining, markets,

and statistics. The rest is devoted to condensed descriptions of location and type of deposits in all important producing countries. . . .

Oil Well Drilling Technology, by Arthur W. McCray and Frank W. Cole, The University of Oklahoma Press, Norman, Okla., 492 pp., \$9.95, 1959—The result of extensive and practical investigation, this volume discusses the geological and geophysical principles governing oil accumulation and the drilling of wells from the standpoint of the driller, petroleum engineer, geologist, and student. . . .

Progress in Nuclear Energy, Series III, Process Chemistry, V.2, edited by F. R. Bruce and others, Pergamon Press, 122 E. 55th St., New York 22, N. Y., 579 pp., \$17.50, 1958—Reports on progress in chemical processing that has occurred since the first volume of the series appeared in 1955. The scope of the subjects includes not only the preparation of those chemical intermediates which occur between crude concentrates obtained from ores and feed materials for reactors, but also on recovery processes for the treatment of ores and irradiated fuels. . . .

Mining and Petroleum Legislation in Latin America, Vol. I. South America, Pan American Union, Div. of Sales & Promotion, Washington 6, D. C., 169 pp., \$5, 1959—A summary by country of laws concerning concessions, rights of ownership, refining, exploitation, transportation, and taxation comprise this helpful work. Its principal aim is to simplify the task of investors by providing a quick view of legal provisions. . . .

Who's Who in Engineering, 1959 edition, Lewis Historical Publishing Co. Inc., 265 W. 14th St., New York 11, N. Y., \$22.50, 1959—A comprehensive biographical volume of the nation's outstanding engineers, including a directory of engineering and engineering-connected groups. . . .

Index of Topographic Mapping in California, Bulletin 79, California Dept. of Water Resources, is available from Documents Section, State Printing Office, Sacramento, Calif. An incorrect ordering address was given in the May issue. The price should have been \$2.50.

BOOKS

(Continued
from page 659)

STATE PUBLICATIONS

Arizona

Dept. of Mineral Resources
Mineral Bldg.
Phoenix, Ariz.

19th Annual Report for July 1, 1957-June 30, 1958, gratis, 1958.
47th annual report of the mine inspector for the year ending Nov. 30, 1958.

Michigan

Geological Survey Div.
Dept. of Conservation
Lansing, Mich.

Reconnaissance of the ground-water resources of Mackinac County, Michigan, Progress Report 19, 1958.
Summary of ground-water conditions in Michigan, Water Supply Report 2, 1958.

Montana

Bureau of Mines & Geology
Room 203-B, Main Hall
Montana School of Mines
Butte, Mont.

Geology of the Dryhead-Garvin Basin, Big Horn and Carbon Counties, Montana, Special Publication 17, 40¢, 1958.
Proceedings of the 1st Symposium on Hydraulic Fill, 1958.

Nevada

Bureau of Mines
University of Nevada
Reno, Nev.

Nevada mines, mills, and smelters in operation as of July 1, 1958, 1958.
Physical Beneficiation of Low-Grade Uranium Ores, available from the Office of Technical Services, Dept. of Commerce, Washington 25, D. C., \$2.75, 1959.

New Mexico

Bureau of Mines and Mineral Resources
Campus Station
Socorro, N. M.

Scenic Trips to the Geologic Past, Part 4, Southern Zuni Mountains, New Mexico, 25¢, 1958.
Reconnaissance Geologic Map of Playas, Geologic Map 7, 50¢, 1959.
Reconnaissance Geologic Map of Dog Mountains Quadrangle, Geologic Map 8, 50¢.
Foster Canyon Quadrangle, Valencia and McKinley Counties, New Mexico, Geologic Map 9, 50¢.
Middle Pennsylvanian Brachiopods from Mud Springs Mountains and Berry Hills, New Mexico, Memoir 3, \$1.25.
The Mississippian of West-Central New Mexico, Memoir 5, \$1.75.
New Mexico and Its Natural Resources, 1960-2000, Publication 55, available from University of New Mexico, Dept. of Government, Albuquerque, N. M.

New York

Geological Survey
State Education Bldg.
Albany 1, N. Y.

Geological Research in New York State, Newsletter No. 10.

North Dakota

Geological Survey
Wilson M. Laird
Grand Forks, N. D.

Thirty-ninth Annual Report, Coal Mine Inspection Dept., State of North Dakota, Bismarck, gratis, 1957.
Bibliography of the Geology and Natural Resources of North Dakota, \$3, reprint.
Fortieth Annual Report, Coal Mine Inspection Dept., State of North Dakota, gratis, 1958.
Report on upper Madison group facies in northwestern North Dakota, Report of Investigations 31, reprint 1958.
30th Biennial report to the State Board of Higher Education, July 1, 1956 to June 30, 1958.

Pennsylvania

Mineral Industries Experiment Station
Pennsylvania State University
University Park, Pa.

Future Energy Sources for Pennsylvania, Circular 53, \$3, 1958.

U. S. BUREAU OF MINES

Copies sold through:

Superintendent of Documents
Government Printing Office
Washington 25, D. C.

Bulletin 577 Operation of Experimental Plant for Producing Alumina From Anorthosite, \$1.
IC 7881 Cadmium, A Materials Survey, 30¢.
IC 7900 Historical Summary of Coal-Mine Explosions in the United States, \$1.50.
IC 7880 Asbestos, A Materials Survey, \$1.25.
Bulletin 575 Occurrence and Determination of Germanium in Coal Ash From Power-plants, 50¢.

Request free publications from:

Publications Distribution Section
U. S. Bureau of Mines
4800 Forbes St.
Pittsburgh 13, Pa.

RI 5441 Damping Capacity—Its Measurement and Significance.
RI 5442 Acid-Ferrous Sulfate Leaching of Low-Grade Manganese Carbonate and Oxide Ores, Cuyuna Range, Minnesota.
RI 5443 Air-Cooled Crucibles for Cold-Mold Arc Melting.
RI 5444 Experiments in Concentrating Lead sulfide Slime.
RI 5445 Heats of Formation of Lanthanum Chloride, Lanthanum Sulfate, and Lanthanum Sulfate Ennehydrate.
RI 5446 Reconnaissance of Nevada Manganese Deposits.
RI 5450 Core-Drill Sampling of Cuyuna-Range Manganiferous Iron Formations, Crow Wing County, Minn.
RI 5453 Carbonization Properties and Petrographic Composition of Hershaw Coal from Boone County, W. Va.
RI 5454 Spectrographic Analysis of Rare-Earth Elements.
RI 5455 Carbonizing Properties of Allegheny County, Pa.
RI 5456 Fischer-Tropsch Synthesis in a Fluidized-Catalyst Reactor With a Nitrided, Fused-Iron Catalyst.
RI 5457 Communication of Flame Through Cylindrical Channels.
RI 5459 Volatilization of Tin Chloride From Bolivian Slimes.
IC 7874 Methods and Practices for Producing Crushed Granite, Weston-Brook Co., Warren County, Ga.
IC 7875 Mining and Milling Methods and Costs at the Indian Creek Mine, St. Joseph Lead Co., Washington County, Mo.
IC 7876 Some Aspects of the Coal Industry of U. S. S. R.
IC 7877 Zinc-Ore Mining and Milling Methods, Piquette Mining and Milling Co., Tennyson, Wis.

ABSTRACTS

In This Issue: The following abstracts of papers in this issue are reproduced for the convenience of members who wish to maintain a reference card file and for the use of librarians and abstracting services. At the end of each abstract is given the proper permanent reference to the paper for bibliography purposes.

Moss No. 3 Mine's New Coal Preparation Plant—One of the richest virgin seams of high quality metallurgical coal is now being mined at the Pittston Co. Moss No. 3 mine. By the end of 1959 it will be producing at the rate of 9 million tons a year. A huge new automated preparation plant helps make it possible. Ref.: MINING ENGINEERING, July 1959, p. 684.

Trends in the Application of Geophysics by Walter E. Heinrichs, Jr.—A resume of the actual situation of geophysics in mining—where, how, for what purposes, and at what costs—based on the current picture of exploration in Arizona. Since World War II exploration geophysics has derived its scope from the following factors: first, the usual post-war interest in exploration to rebuild war-depleted reserves; second, the impetus supplied by the uranium prospecting boom; third, increased demand for natural resources due to the Korean War; fourth, the discovery

of substantial metallic ore by geophysical means in Canada, the U. S., and other countries; and, finally, continuing discoveries of commercial oil by geophysical methods throughout the world. Ref.: MINING ENGINEERING, July 1959, p. 688.

Designing for Tailing Disposal in the Southwest by E.V. Given—Designing a tailing dam is a major step toward fully integrated mill operation. In the case of large concentrators considerable planning is necessary. Pointers on planning effective, adequate disposal areas are included in this paper. San Manuel found that use of cyclones saved the day when tonnage outran tailing dump space, and made for firmer dam faces as well. Ref.: MINING ENGINEERING, July 1959, p. 691.

Differential Thermal Analysis for Ore Treatment Study by William I. Watson—Many of the knottiest problems in mineral treatment involve finely divided materials or slimes. Clays and similar materials are often encountered and these are particularly suited to study by differential thermal analysis. This technique can give information not readily obtainable by any other method. Even with its limitations, the method should receive greater consideration by people in the mining industry. Ref.: MINING ENGINEERING, July 1959, p. 694.

The Gem Steels and Adjacent Orebodies by Garth M. Crosby (TP 48101)—Seven mines with important production records in the Coeur d'Alene mining district are located adjacent to Gem Steels—the Frisco (Gem), Hercules, Interstate, Rex (Sixteen to One), Success (Granite), Sunset, and Tamarack. Old records are incomplete, but available data show these mines have produced 10, 550, 221 tons of ore containing more than 50 million ounces of silver, over 1,500,000,000 lb of lead and about 1 billion lb of zinc, or approximately 1,250,000 tons of lead and zinc combined. This impressive production record represents about 12 pct of the yield from the Coeur d'Alene mining district, and at present metal prices with modern beneficiation would have a gross value of \$400 million. The Hercules mine alone produced one half the lead, and the Interstate and Tamarack mines produced over one half the zinc. The silver ratio ranges from 0.4 (ounces of silver per unit of 20 lb of lead) at the Hercules mine to a high of 0.8 at the Hercules mine. The average silver ratio for the group of mines is 0.65. The Hercules mine produced the highest grade lead ore, its 3,500,000 tons averaging about 11 pct of the metal. Though the Interstate mine produced a little less than 1 million tons of ore it averaged the astonishing grade of 17.4 pct Zn. The average grade of ore for the group of mines is approximately 4.8 ounces of silver per ton, 7.2 pct lead and 4.6 pct zinc. Ref.: (MINING ENGINEERING, July 1959) AIME Trans. vol. 214, p. 697.

A Case History in Pillar Recovery by John J. Reed (TP 4811A)—The mines of the south-east Missouri lead belt have been in operation since 1864. About 10 pct of the total ore available has been left in place as pillars, and this now represents the best ore reserve left to the older mines. St. Joseph Lead Co. has been investigating various plans of pillar recovery for several years, and the example to be described is only one possible approach under a specific set of conditions. Conditions vary greatly in the different areas within the lead belt, and the same approach would be entirely inadequate in certain other areas, but there are important sections where this system is clearly applicable. Ref.: (MINING ENGINEERING, July 1959) AIME Trans., 1959, vol. 214, p. 701.

Thorium and Uranium Resources in Monazite Placers of the Western Piedmont, North and South Carolina by W. C. Overstreet, F. K. Theobald, Jr., and J. W. Whitlow (TP 4807H)—Monazite placers in the western Piedmont of the Carolinas, explored by the U. S. Geological Survey in 1951-1954, are estimated to contain at least 53,000 short tons of ThO₂ and 4600 short tons of U₃O₈. None of these deposits is being mined. Ref.: (MINING ENGINEERING, July 1959) AIME Trans., 1959, vol. 214, p. 709.

Flocculation to Improve Coal Slurry. A Laboratory Investigation by M. R. Geer, P. S. Jacobsen, and H. F. Yancey (TP 59F34)—Experimental results appear to support two principal conclusions: First, all three natural and three synthetic slurries tested exhibited individual flocculation characteristics and individual flocculation properties; moreover, their behavior was not related directly either to size composition or to ash content. Thus each slurry must be evaluated individually for possible benefits of flocculation to be predicted. Substantially the same conclusion was reached by Meerman, whose investigation was on a full plant scale. Second, some of the newer flocculants are so effective

that only a few thousandths of a lb per ton are needed, but with the slurries examined the performance obtained did not exceed that possible with greater amounts of starch. Ref.: (MINING ENGINEERING, July 1959) AIME Trans., 1959, vol. 214, p. 715.

Advancing Through Caved Ground with Yieldable Arches by James Guigley (TP 482-F)—The development of various sizes and sections of arches by steel manufacturers continues, and a variety of dimensions and shapes are available offering uniform dependable support easily installed and maintained. As shallow mineral deposits are mined out, the loads imposed on the remaining rock by the mining processes and the depth of cover will necessitate the type of support the yieldable arches give. Ref.: (MINING ENGINEERING, July 1959) AIME Trans., vol. 214, p. 720.

Meteorological Influence on Radon Concentration in Drillholes by A. B. Tanner (TP 4804L)—The concentration of radon in drillholes in uraniferous limestone near Grants, N. M., was observed to change markedly with different meteorological conditions. Continuous records of wind velocity, surface temperature, and atmospheric pressure were obtained for a 20-day period during which a series of analyses was made for the radon content of air collected at several depths in a 4 1/2 in. diameter drillhole. More limited investigations were made of several other drillholes. Ref.: (MINING ENGINEERING July 1959) AIME Trans., 1959, vol. 214, p. 706.

SME Meeting Papers: The following abstracts of papers presented at SME meetings are given for your information. Copies of these papers are available only if followed by a preprint order number. These preprints are obtained on a coupon basis. The coupon books may be purchased from SME headquarters for \$5.00 a book (10 coupons) for members of AIME or \$10.00 a book for nonmembers. Each coupon, properly filled out, entitles the purchaser to one preprint. Mail completed coupons to Preprints, Society of Mining Engineers, 29 W. 39th St., New York 18, N. Y.

Structural Concrete Made with Lightweight Aggregates by J. J. Shideler—The paper includes a brief description of method of manufacturing lightweight aggregates, and a discussion of structural properties and current uses of lightweight aggregate concrete. The aggregates considered in the paper are expanded shales, clay, slate, and slag with sand and gravel used as a standard of comparison. The concretes under consideration weigh between 100 and 115 lbs per cu ft and have compressive strengths in excess of 3000 psi. The structural properties of concrete including compressive and flexural strength, elastic properties, bond, creep and shrinkage, are presented for several lightweight concretes and one sand and gravel concrete. The principal uses of structural lightweight concrete are: cast-in-place floors for multi-story construction, decks for long span bridges, precast members for floors and roofs and precast wall panels. High quality concrete suitable for structural use can be obtained with many lightweight aggregates currently available. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

Limestone Mines—Their Commercial and Strategic Potentials by Russell W. Hunt—The planning of operations in the underground mining or quarrying of stone should be carried out with an eye to the potential future use of the worked out mine as an underground opening for defense purposes. In the event of either a quick war or a war of attrition, the strategic importance of underground openings for warehouse or industrial occupancy is recognized. Certain construction features are desirable for any such future use, and these are discussed. Emphasis should be placed during the active mining life on leaving a usable structure rather than an abandoned hole in the ground. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

Curtain Walls of Indiana Limestone by Jasper D. Ward—Discussion of the use of limestone in contemporary buildings employing curtain wall construction. The curtain wall is made up of a metal framework or grid attached to the structural frame of the building. Into this grid is placed glass where light and ventilation is needed, and opaque materials be-

low the window still covering the floor construction below. This opaque covering is called a spandrel. The Indiana Limestone Co. has developed a panel of full spandrel size made up of 1 1/2 in. limestone backed by insulation and fabricated for each job in the mill. This panel is lightweight in keeping with the curtain concept yet retains all the advantages of the natural stone. Discussion to include fabrication, finishes, types of insulation, and installation in wall grid. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

Competition of Artificial Dimension Stone by W. F. Mullen—Substitutes for natural dimension stone have been aggressively promoted and widely distributed in recent years. Some of these now enjoy a significant share of the market. The competition is mainly from plastics, concrete products, glass, steel, aluminum, porcelain enamel, asphalt, rubber, and cork products. The products affected include pillars, spandrels, laboratory furniture, sills, roofing, flooring, and chalkboards. A brief history of each development is given, singular characteristics of each product are listed, and public acceptance is analyzed. Suggestions to the stone industry for recapturing this market are discussed in some detail. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

Gypsum in Indiana by Richard A. Teichman, Jr. and William B. Fergusson—This paper discusses the occurrence of gypsum in Indiana, the development of the data which led to the exploration and development drilling of the properties, and the subsequent commercial exploitation of the deposits. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

Quality Control in Refractory Raw Materials by O. M. Wickers and C. P. Cook—Pennsylvania clays and gannister are discussed from point of view of eliminating undesirable impurities. Control starts with exploration and core drillings, ends with mechanical separation and blending. Nature of impurities and effect on refractories is shown. Joint Coal-IndMD Meeting, Bedford Springs Pa., September 1959.

Study of Mechanism and Rate of Ilmenite Weathering by Langtry E. Lynd—Results of etch tests on a large ilmenite crystal indicate that ilmenite is most readily attacked by acid solutions along twin lamellae, and on 001 planes. The type of alteration observed in New Jersey sand ilmenites is quite different from that present in rocks of the area from which the sands were probably derived, indicating that the sand ilmenites were altered after disintegration of their parent rocks. Simulated weathering experiments on ilmenite indicated that the most effective weathering agents were those likely to be present in rain and ground water are humic acid and sulfuric acid. Sea water and other alkaline solutions did not attack ilmenite appreciably. The rate of alteration of ilmenite by simulated weathering solutions was found to be highly dependent on the pH of the solution used. By extrapolation of the experimental data, it was estimated that the time required to produce altered ilmenites like those of Florida or Indiana ranges from a few thousand years at a pH of 3.25, up to several million years at a pH of 5.9. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

The Role of Technical Fibre (Asbestos) Sales in Today's Market by D. L. Monroe—Today's market conditions call for the most efficient use of raw materials. Asbestos fibres are being subjected to increasingly more examination and evaluation in the customer's processes and the asbestos supplier is called on to assist, particularly in the matter of test procedures, in this evaluation. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

The Application of Flocculants to the Clarification of Coal Washery Waters by K. C. Lindstrom and R. H. Oliver—The installation of coal washery water clarification equipment is justified on the basis of one or a combination of three results, prevention of fines buildup in circulating plant water, production of more saleable product per t of mined coal and compliance with State pollution regulations. The proper use of flocculants permits the coal washery operator to attain these objectives at a minimum annual cost.

This paper presents six typical coal washery flow sheets along with a discussion of the place of water clarification equipment in these flow sheets. The flocculants currently available to the coal washery operator are listed in a table along with the information required for their use. Each flocculant is discussed in relation to its range of pH effectiveness, method of preparation, strength of solution, method of addition, commercial dosage and price per lb.

Suggested testing procedures for evaluation of flocculants in the clarification, thickening, and filtration of coal washery waters are also included. The paper contains two nomographs for the conversion of laboratory test data to the plant figures of lbs of flocculant per t of solids or lbs of flocculant per thousand gals of washery water. These figures are used for the economic determination of which flocculant, if any, and what dosage are required to produce the lowest annual cost of both the water clarification equipment and the flocculant. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

Recovery of Solids From Water Systems, Wharton No. 2 Preparation Plant by R. L. Llewellyn—Water clarification and solids recovery from a Baum Jig-Deister table plant were combined into one problem at this 6000 tpd mine in West Virginia to comply with the stream pollution regulations. Tests were made of the plant bleed to establish the capacity of the equipment involved. A combination of cyclones, thickener, and filter systems was installed to classify the fine coal solids and to obtain clarified water by flocculation for reuse in the washery circuit. A series pumping circuit was installed to waste the extremely fine solids to a disposal area nearby. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

Maintenance of Water Clarification Equipment by J. J. Reilly—Location of the Vesta mines, type of mining, size of the particles fed to the water clarification equipment, the uniformly good quality metallurgical coal will be covered in the discussion. Most of the time will be spent describing the number and size of pumps at each location, the thickening and filtering equipment, classifiers and pipe lines, regarding maintenance procedure and life of the equipment. Paper will also discuss the maintenance of the sludge pond. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

Some Geological Factors Affecting the Upper Freeport Coal and Its Quality by Edwin F. Koppe—The upper Freeport coal in the Freeport and New Kensington quadrangles, Pennsylvania, varies from a bony streak to a thick deposit of the "Double" or "Thick" Freeport often exceeding ninety inches. Distinctive basal partings, a central bone layer, and a canneloid top bench may be present. The appearance of a sandstone roof, sandstone rolls, and bony coal at the top of the main coal bench can be anticipated in thin Freeport areas when basal partings are absent. When the two basal partings are present, a shale roof is normal. These effects are correlated with the original topography upon which the coal was deposited. The original depositional high areas tend to coincide with present structural highs.

Preliminary data indicate that coal quality, in part, is affected by the depositional setting. In "high" areas, a tendency exists for the main coal bench to contain higher percentages of fusain, mineral matter, and other petrographic components. Within limits, somewhat higher ash fusion temperatures appear to correlate with paleotopographic highs. As a result of these findings, critical examination of the paleotopography and related parameters is indicated in other basins and other coals. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.

Disposal of Sulphur Mine Effluents by P. D. Bybee and F. G. Deiler—Introductory remarks include a brief synopsis of the Frasch system of sulphur mining as employed by Freeport Sulphur Co., describing the removal of sulphur well formation water (bleed-water). The section includes a discussion of earlier tests and accompanied difficulties encountered in lowering or removal of the objectionable constituents from the effluent in an effort to render the waste innocuous to wild life. Detailed characteristics of bleed-water and its comparison to sea water are presented, followed by the approved methods of treating the effluent so as to reduce the sulfide concentrations to a harmless level. The collection, treatments, and disposal of bleedwater for each of the various sulphur mining properties: Grand Isle, Grand Island Bay, Bay Ste. Elaine, and Chacahoula are discussed as well as the proposed methods for the future mining sites at Lake Pelto and Offshore from Grand Isle. Testing the efficiency of the waste disposal treatments is revealed through the elaborate system of water sampling at strategic locations followed by subsequent chemical analysis by qualified personnel. Surveys, conducted by independent laboratories and periodical biological inspections at each property are discussed as well as miscellaneous facets of the pollution control program. The salient biotic constituents in the various impounding basins and their effects on the environment are described. Brief remarks on Public Relation and Freeport Sulphur Co.'s complete cooperation with regulatory agencies are discussed followed by the summary. Joint Coal-IndMD Meeting, Bedford Springs, Pa., September 1959.



**This No. 12 has to be dependable because
"if the trucks can't move, the mine can't operate"**

The Cat No. 12 Motor Grader, maintaining a strip mine haul road in Kingwood, W. Va., is a key machine.

"Keeping the haul road open for 14 to 27 trucks to move 1,000 tons of coal a day is vital. If the trucks can't move, the mine can't operate," explains C. G. Robertson, vice president of the Kingwood Mining Company. "The reason we use a Caterpillar machine is there is less down time and it's economical to operate."

This No. 12 operates the year around, 96 hours a week. It works over the 3½-mile haul road in just four hours. Other times it is used for clean-up work.

There are a number of reasons for its high production and dependability. Operators have good visibility. The mechanical controls they operate offer positive action, make blade adjustments precise. And now the all-transistor Preco Automatic Blade Control is available. It controls blade slope to an accuracy of 1/8 of an inch in 10 feet regardless of position of the grader or the unevenness of the terrain.

Another exclusive is the oil clutch which provides up to 2,000 hours without adjustment.

The 115 HP No. 12 is just one of a family of Caterpillar Motor Graders designed to do more work at lower cost with less down time than any other units in their class. There is also the 75 HP No. 112 and the big, new 150 HP turbocharged No. 14—the most versatile big grader ever developed.

If you have a job that can't afford excessive down time, see your Caterpillar Dealer. Ask to see the Cat Motor Grader that best fits your needs.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

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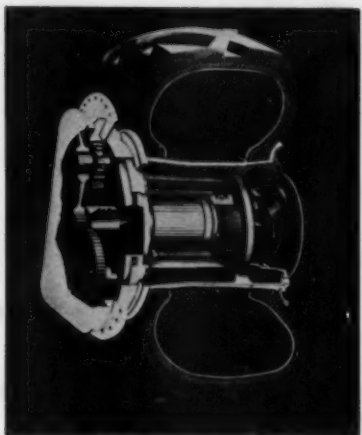
**LESS DOWN TIME.
MORE PRODUCTION...
CAT MOTOR GRADERS**

MANUFACTURERS NEWS

NEWS / EQUIPMENT / CATALOGS

Motorized Wheel

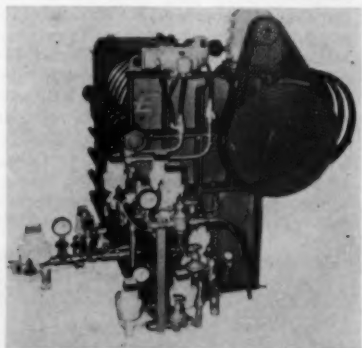
A new motorized wheel built by General Electric can provide open pit earthmovers with new versatility. The electric traction motor is included as an integral part of the wheel, eliminating transmissions, axles, and gearshifts. Motor requires power from a single d-c generator driven by the vehicle's engine. Drive makes possible a 60-ton



hauler combining high performance with the maneuverability of a vehicle one third the size. Wheel provides safer, faster stopping through use of dynamic braking, in which the energy is dissipated as heat to bring the vehicle to a stop.

Automated Filter

A fully-automated version of the improved Eimco-Burwell filter has been built by Eimco Corp. for a metals processor. New filter is equipped



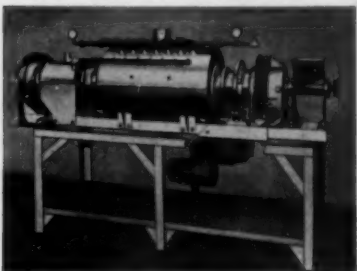
with an electric timing control circuit and all auxiliaries for multi-cycle operation. Filter can end one filtration cycle and start another without attention of operator. **Circle No. 1.**

Self-Advancing Roof Support

A hydraulically-powered self-advancing roof support system by Dowty Mining Eqpt. Ltd. provides constant protection for continuous coal miners and their support teams. Called the Dowty Canopy, the system is released, advanced, and reset by simple valve controls. **Circle No. 2.**

Research Calciner

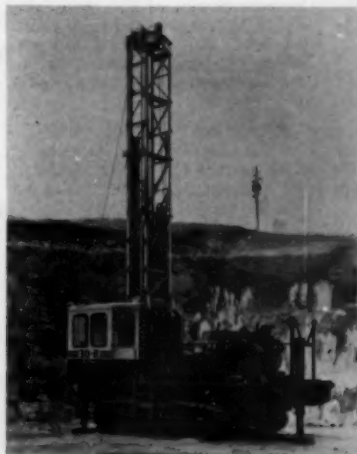
A research-size continuous rotary combination calciner and cooler is offered by C. O. Bartlett & Snow Co. Material can be heated to a maximum of about 2000°F and cooled to



150 to 200°F before discharge. Fuel-fired or electrically-heated, the unit is available in two lengths: 8 ft 11 in. or 14 ft 2 in. **Circle No. 3.**

Rotary Blastholer

Bucyrus-Erie Co. has introduced the model 30-R, a new medium-sized heavy-duty rotary drill for 6½ to 7½-in. blastholes. Pipe rack holds five lengths of 3-in. diam, 21-ft pipe. Exclusive rack and pinion cable pull-down is capable of 30,000-lb force on bit. Crawler or truck mountings are offered. **Circle No. 4.**



Dredge Pumps

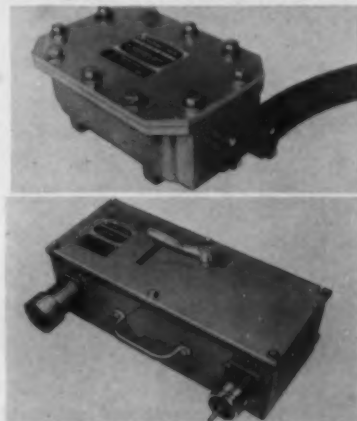
Better sand and gravel production at lower cost is the claim for the Durable dredge pumps made by Thomas Foundries Inc. Sizes range



6 to 16 in. and all pumps feature Ni-Hard alloy working parts. To absorb shock and prevent breakage by large heavy rocks, a water jacket is provided between shell liner and outer casing. Pumps also serve for pumping mine refuse. **Circle No. 5.**

Safety Sentry

A new device known as the Lecronic Sentry gives positive protection against ground faults and short circuits on all d-c operated off-track mining machines and their trailing cables for the first time, according to Joy Mfg. Co., Electrical Products Div. Two-part unit consists of transmitting and receiving elements.



Whenever continuous monitor signal of sender (upper photo), attached to mining equipment, is interrupted the receiver (lower photo), part of automatic circuit breaker at outby end of cable, acts instantly to cut power. USBM has accepted unit for use on permissible equipment. **Circle No. 6.**

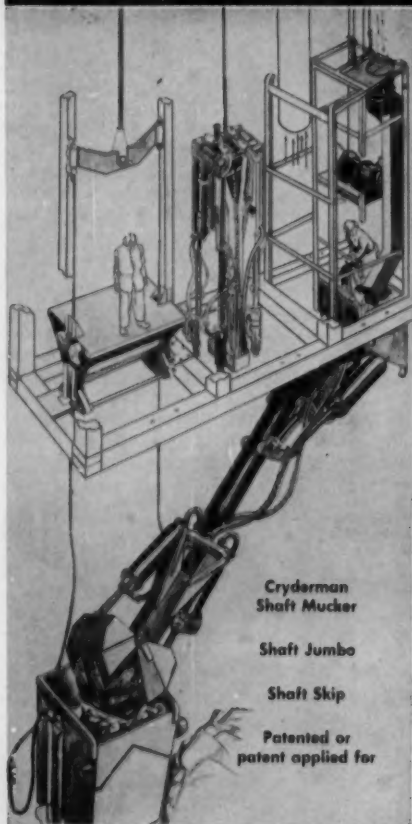
Timber Framer

The No. 284 timber framer by Burke E. Porter Machinery Co. accurately and quickly processes (Continued on page 664)

Cryderman

SHAFT MUCKER

breaks the barrier to
speed in shaft sinking



As modern as jet flight and as revolutionizing in accelerated speed, the CRYDERMAN Shaft Mucker now offers you the tested short-cut to shaft sinking results achieved in far less time and with far less manpower. Exclusively a CRYDERMAN creation, from custom design to finished products, this rugged equipment is your best assurance of lower cost operation.

CRYDERMAN SHAFT MUCKER

CRYDERMAN accomplishes both digging and loading. One man, from the safety of the cage, operates the machine, applying positive bucket placement and positive digging pressure at the touch of the joy-stick controls. Fan clears shaft for safe re-entering minutes after the blast.

SHAFT JUMBO

The collapsible shaft jumbo assures simplified, low-cost drilling, quick set-up and positive steel pulling.

SHAFT SKIP

Square design of the shaft skip holds 70% more load than round buckets. Automatic dump and safety device to prevent falling are features of this unique skip.

This is entirely new and highly successful approach to shaft mucking — sinking as far as 24 feet in 24 hours! The one machine that handles both vertical and incline shafts. Write for details on the CRYDERMAN System or specially designed and custom built equipment.

Machinery Center, Inc.

1201 So. 6th West • Salt Lake City, Utah • HUner 4-7601

Shaft & Development Machines, Inc.

808 Newhouse Building • EMpire 3-5373 • Salt Lake City, Utah

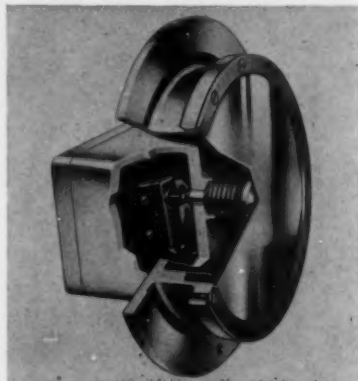
Manufacturers' News

(Continued from page 663)

frame, crib, and shoring members for mine and construction work. Heavy timbers, either rounds or cants, are fed into the machine, which double-end trims, cuts clean sharp tenons, and discharges at the rate of about three pieces per min. Operator can sequence movements from push button station. Circle No. 7.

Bin Level Indicator

The new all-metal Auto-Bin-Dicator automatic bin level indicator with stainless steel diaphragm and supersensitive response mechanism is suitable for use with high and



low-density, coarse and fine materials and is highly corrosion resistant. Unit will operate signals, start and stop material flow, etc. Standard and explosion-proof models are available from Bin-Dicator Co. Circle No. 8.

News & Notes

Bucyrus-Erie Co. plans a research center on its 125-acre Oak Creek, Wis., test ground . . . Fuller Co. will manage the business of Traylor Engineering & Mfg. Co., which was purchased recently. Fuller, subsidiary of General American Transportation Corp., says personnel and facilities will otherwise remain unchanged . . . International Minerals & Chemical Corp.'s new administrative and research center in Skokie, Ill., has received two building awards . . . General offices, manufacture of Krebs cyclones, engineering, pilot plant, and laboratory of



Eqpt. Engineers Inc. have been consolidated in new quarters (see photo) at Palo Alto, Calif.

(21) **ELECTRIC BLASTING:** *Atlas Powder Co.* announces a new "Handbook of Electric Blasting," a 60-page manual which makes plain the whys and hows of effective electric blast detonation. Subjects include: advantages of electric blasting over old methods, nature and construction of an electric blasting cap, sources of power for electric blasting. Tables and graphs detail voltage delivered by standard blasting machines and give resistance of copper wire and caps and electric blasting circuits. Methods of splicing wires, testing circuits, checking current leakage, and using rheostats are included in the pocket-size manual.

(22) **HANDLING EQUIPMENT:** *McNally Pittsburgh Mfg. Corp.*'s new 128-page pocket manual 559 gives latest data on coal preparation and handling equipment, with photographs, dimensional drawings, and capacities of each unit. Reference tables and essential engineering data are also included.

(23) **TRACTORS:** *Elmco Corp.* has presented a 16-page catalog of Elmco 105 series tractors. Included are full color pictures of the tractor-dozers, excavator, excavator-dozers, combination, steel mill excavator, and front-end loader, with specifications of each unit. Booklet L-1074 describes special features.

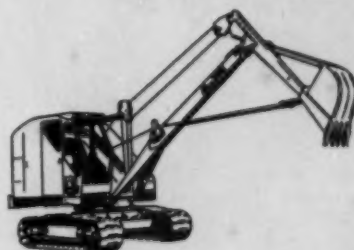
(24) **HANDLING SAND:** Preparing and handling sand for hydraulic stope filling is the subject of bulletin G3-B66 from *Denver Eqpt. Co.* Sand filling offers a safe, quick, cheap means of extraction, reducing fire hazards, dust, stream pollution, and underground transportation.

(25) **WIRE CLOTH:** To accommodate increased demand for very fine mesh grades of square weave wire cloth, *Michigan Wire Cloth Co.* has introduced a new line in 120 to 400-mesh range. Data sheets are now available.

FREE LITERATURE

(26) **TRACK CLEANER:** Heavy duty model 60 Canton track cleaner is pictured in a folder from *American Mine Door Co.* Specifications were dictated by surveys in various mining fields. Parts that received extreme wear were built for durability. The single unit frame is ruggedly constructed of steel shapes and plates. Double row anti-friction tapered roller bearings are used throughout.

(27) **CRANE-EXCAVATORS:** Specification bulletin 350-1 from *Schield*



Bantam Co. covers series 350 Bantams, including an 11-ton crane that is the biggest in the $\frac{3}{4}$ -cu yd field. Rugged high speed performance, one-man operation, independent travel, and 11 front-end attachments are highlights of the Bantam line.

(28) **AIR POWER CAR TRANSFER:** A dramatic folder titled "Easy Does It" advertises the Canton air-power car transfer that loads an entire train on a single track. *American Mine Door Co.* offers data in form 142.

(29) **ELECTRICAL CONNECTORS:** Illustrated catalog B73 has been published by *Joy Mfg. Co., Electrical Products Div.* Electric current ratings for cable are listed and the entire line of connector styles is described in terms of applications, availabilities, contact arrangements, etc.

(30) **SKID-SHOVEL:** Features of the Drott TD-15 skid-shovel by *International Harvester Co.* are depicted in 16-page catalog CR-600-1. Exclusive Drott 4-in-1 bucket providing four prime construction units in one tractor loader is illustrated. Moving a simple machine-selector lever gives the operator a choice of bulldozer, scraper, clamshell, or skid-shovel action.

(31) **WIRE ROPE:** *Colorado Fuel & Iron Corp.* Wickwire rope is the subject of an illustrated folder. The rope's strength is based on correct grain structure, pressure lubrication of dies, special heat treating and fabricating techniques, and tests of careful manufacture. Specifications for different rope requirements in mine and quarry are explained.

(32) **SOLIDS PUMP:** *Morris Machine Works* has released bulletin 189 outlining capacities of type CK solids pump. The new centrifugal unit is designed to handle fluids with random size solids and highly abrasive materials. Effective in dredging operations, the CK is ideal for slurries comprised of sand, coal, tailings, gravel, lime, process wastes, or pulpy mixtures.

(33) **DRILL BITS:** Catalog 50 describes the full line of Blue Demon replaceable blade all-formation drill bits offered by *Herb J. Hawthorne Inc.* A wide range of bits provide for operations of minerals prospecting or test hole drilling. Featured for the first time is a new 4-blade carbide insert rock bit developed for either air or water drilling in tough formations.

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JULY 1959
664A—MINING ENGINEERING

7

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61	62	63	64						

Students should write direct to manufacturers.

(34) **CONTINUOUS BORER:** Catalog G-124 from Goodman Mfg. Co. details type 300 cutting and loading machines. Fully maneuverable for entry driving (including crosscuts), room work, and pillar recovery, the borers have large, rugged parts for long wear and good accessibility for inspection or repair.

(35) **BATTERY CARE:** A comprehensive manual to assist users in servicing and maintaining storage batteries on railway diesel locomotives has been released by Exide Industrial Div. of Electric Storage Battery Co. The fully-indexed 16 pages cover battery fundamentals, charging, inspection, records, maintenance accessories, and trouble shooting.

(36) **ENGINES:** International Harvester Co.'s new UDT-817 engine is the subject of 4-page, 2-color folder CR-684-1. The turbotorque engine develops 385 hp at 2100 rpm. A direct-start model, the unit has a compression ratio of 16:1. Its open-type combustion chamber is designed for direct-injection, efficient combustion of low-cost, high-heat content No. 2 fuels.

(37) **PROTECTIVE SKIN CREAMS:** Three new creams that provide protection against any skin irritant commonly encountered in industry have been developed by Mine Safety Appliances Co. and are explained in bulletin 0403-4. Called M-S-A Fend, the cream comes in three special purpose formulas that combat either water soluble irritants, or water insoluble irritants, or both.

(38) **PUMP:** Wemco, div. of Western Machinery Co. has 4-page bulletin P10-B44 describing varied applications of its non-clog torque-flow pump. Examples of use in the coal, pulp and paper, and chemical industries show how radical design principle makes the pump non-clog and highly abrasion resistant, yet gentle to materials.

(39) **SEPARATORS:** Dorr-Oliver Inc. announces 16-page bulletin 2806 which describes the design, operation, and advantages of Merco centrifugal separators for five basic liquids-solids applications. Photos and drawings of component parts and installations are included.

(40) **SEPARATOR:** A 2-page illustrated bulletin from De Laval Separator Co. describes the Syncromatic separator with three dimensional motion control, horizontal, vertical, and gyratory.

(41) **BULLDOZER:** A 79 pct increase in production on quarry operation requiring stripping of rock-laden overburden and a 60 pct increase on land clearing, stumping, and piling are records amassed by Caterpillar No. 7G bulldozer in competition against No. 7S bulldozer in Missouri and Iowa. Data on the 7G are found in Form 33344 from Caterpillar Tractor Co.

(42) **PLASTIC PIPE:** Hi-Mol, a tough, flexible plastic pipe eliminates stress cracking, according to Carlon Products Corp. The pipe is made from virgin polyethylene of a unique molecular structure.

(43) **DESIGN TOOL KITS:** Scott Industries Inc. has announced an assemble-it-yourself machine tool kit for economical plant layout in scaled 3 dimensions. Ask for the catalog, "Designing in 3-D."

(44) **COAL CONVEYOR:** A data sheet from Daniels Co. describes the type C fully enclosed and preassembled flight conveyor for coal handling. Built in standardized sections, various combinations are adaptable to any type of service.

(45) **OXYGEN METER:** Details of operation of the Hays dissolved oxygen meter are available in data sheets from Hays Corp. The meter automatically and continuously records dissolved oxygen in surface waters.

NEW FILMS

Taming a New Frontier, a 16-mm, color, sound movie of the building of the gigantic Glen Canyon Dam in northern Arizona, has been released by International Harvester Co. It runs 27 min and shows modern construction techniques, community development, and monumental engineering effort. The film was produced in cooperation with the U.S. Dept. of Interior's Bureau of Reclamation and Merritt-Chapman & Scott Corp., prime contractor. To obtain the film on loan write Consumer Relations Dept., International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill.

Refining Copper From the Sudbury Nickel Ores is a film employing unusual techniques to relate the story of copper refining. This 39-min sound-color film shows the interior of International Nickel Co. of Canada Ltd.'s anode furnaces during "poiling" operations and in process of electric direct arc melting of pure copper. Special heat-absorbing glass and asbestos shields protected cameramen for close range sequences. Produced for Inco by Film Graphics Inc., the film is available from International Nickel Co. Inc., 67 Wall St., New York 5, N.Y. No rental or mailing charge.

Earthmoving methods before the machine age, and the story of earthmoving equipment from its inception to the present day are highlighted in the 20-min 16-mm motion picture *Crawler Tractors in Action*. Job locations and construction details are well illustrated. Film may be borrowed from Allis-Chalmers Construction Machinery Div. branches and dealers throughout the country.

And A Great Deal More, a 19-min color-sound movie depicting the uses of TractoLoaders, has been released by Tractomotive Corp. Spot scenes showing the TL-20D TractoLoader and TL-16 TractoLoader in action, and highlights of the unique hydraulic system with full flow micron filter plus screen and magnetic filters, fill the movie. It can be seen at local Allis-Chalmers construction machinery dealers.

A new film, *What's In A Name*, has been produced by Gardner-Denver Co. to show how the firm, celebrating its Centennial in 1959, grew from a one-room shop into a world-wide company. The 17-min sound-color film describes the development of Gardner-Denver since it was founded in 1859 and a governor for steam engines was its first product. It can be obtained by writing Film Library, Gardner-Denver Co., Quincy, Ill.

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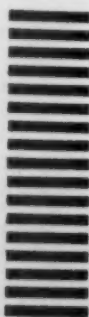
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FOR CONTINUOUS SERVICE IN HEAVY DIGGING **MARION 181-M**

The new levels of output and efficiency made possible on operations that can use large haulage units make the Marion 181-M a logical machine for expanded pit mining operations.

Here's a husky 8-yard machine with the traditional strength, power and endurance of Marion mining shovels - - plus small machine cycle time for an extra payoff every day.

With low-maintenance Ward-Leonard controls, power is applied smoothly and quickly,

yet held within controlled limits that safeguard the machine against undue shocks or strains.

The chain propel simplifies crawler design and provides increased protection for the final propel mechanism, especially on shovels where the drive chain is enclosed and dips in oil.

A disc-type air clutch permits the operator to engage the travel mechanism without stopping the machinery, permitting faster move-ups.

If you haven't seen Bulletin 439 on this 8-yard Marion, write for your copy today.

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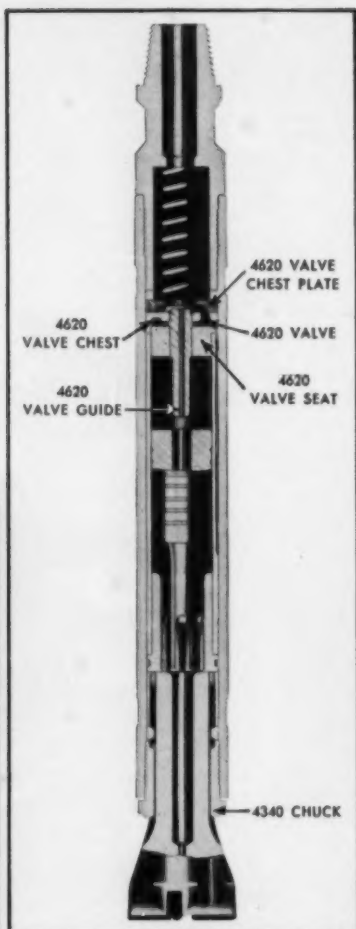
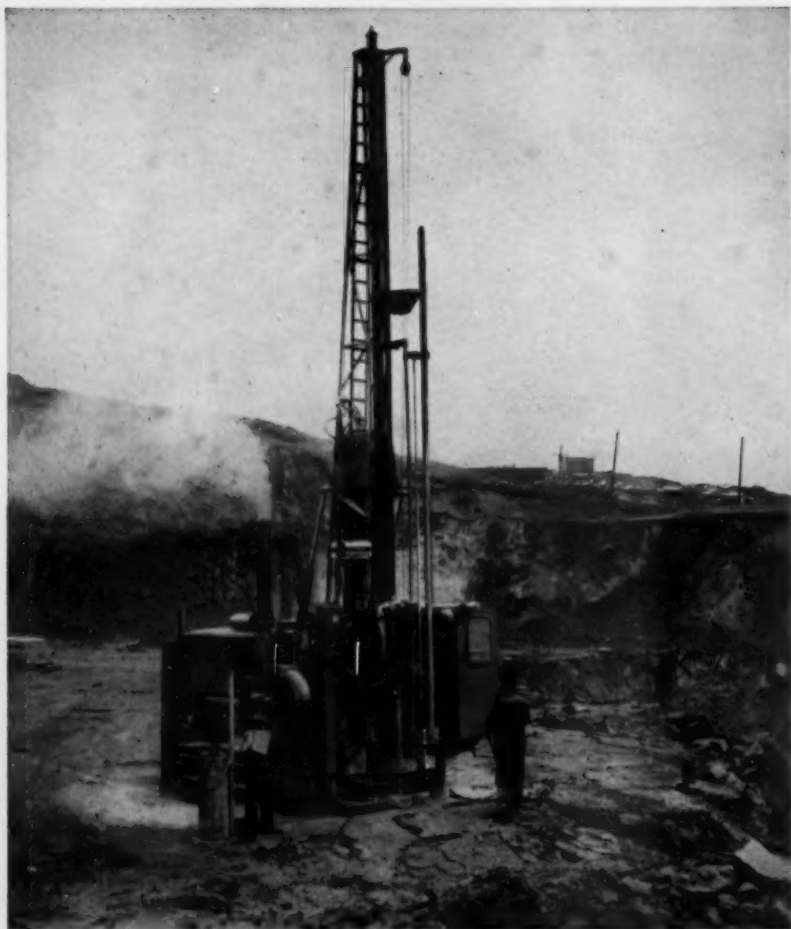


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for lowest costs on your property!

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The drill goes right down the hole with the bit in this Ingersoll-Rand percussion drill. The piston strikes the bit shank directly, with 1,000 blows per minute.

I-R Downhole drill gives "all-rock" versatility with rugged nickel alloy steels

Ingersoll-Rand is putting nickel alloy steels to work in one of the toughest mining and quarrying applications — drilling. Each Downhole drill has parts made of nickel-containing steel . . . parts that require high strength, toughness and hardness to stand up under equipment-wrecking conditions.

In mile after mile of hole — in every drillable rock — the Downhole drill has proved itself with these nickel alloy steels:

Tough, Hard 4620 Nickel-Molybdenum Steel — a truly ideal alloy for the air valve, seat, guide, chest and


chest plate. This steel, when carburized, develops a good hard case with a bonus in core toughness and impact resistance . . . and it exhibits minimum distortion in heat treatment. This is especially important where critical tolerances are involved.

Strong 4340 Nickel-Chromium-Molybdenum Steel is used for one of the most critical parts — the chuck. Where the combination of high strength and toughness becomes crucial, nothing matches oil quenched and tempered 4340.

Ingersoll-Rand knows that nickel alloy steels provide the superior

properties needed to keep mining and quarrying equipment operating day after day with a minimum of repairs. If you have metal parts that don't stand up, why not let nickel alloy steels prove their worth to you?

These two nickel alloy steels are carried by Steel Service Centers from coast to coast. For a list of sources, for information that will help you with your metal problems, write Inco.

The **INTERNATIONAL NICKEL COMPANY, Inc.**
67 Wall Street  New York 5, N. Y.

INCO NICKEL

NICKEL MAKES ALLOYS PERFORM BETTER LONGER

Competition for Natural Gas?

Blowing coal through 100-mile pipelines is envisioned in proposals being studied by two firms in this country. Rather than pump a slurry (now being done), dry coal would be reduced to -5μ by *impact shattering* and blown at initial pressure of 300 psi. Fluidized material can be burned in industrial furnaces on arrival or stored on arrival, much like gas—but contains more Btu per cu ft than natural gas. Much development remains, but key pulverizing step is reported proven.

Weed Bids Government Hold Copper

Clyde E. Weed, Anaconda Co. chairman, recommended that the Government carefully consider a suggested plan that surplus stockpile materials be released through regular trade channels only when the open market price passes a gap indicating a real domestic shortage. "It is my personal belief," he said, "that this indicative price should be in the neighborhood of 35¢ per lb in the case of copper." Commenting on the relationship between wages and both output and price of copper, he said "If costs are increased beyond productivity, then higher prices are necessary. If higher prices are not possible, then employment must be curtailed or reduced completely. It is that simple."

Canadian Sulfur Extraction Plant

A sulfur extraction plant, capable of producing 100,000 tons of elemental sulfur annually from *sour gas* wells, started production June 3 at Okotoks, Alberta. Facilities are jointly owned by Texas Gulf Sulphur Co., Devon-Palmer Oils Ltd., and Shell Oil Co., Canada, Ltd.

Big Slash in Price of Tantalum

Union Carbide Metals Co. announces that increased output and higher demand have resulted in a cut in the price of high purity tantalum, from \$60 a lb to \$35.

U. S. Steel Demonstrates New Ore Reduction Process

Nu-Iron, a fluidized bed reactor process recently developed by U. S. Steel has been demonstrated at the South Works in Chicago. By the process, a bed of finely divided ore particles is contacted with a reducing gas to produce pig iron, without the use of high grade coke. Work goes on toward obtaining data for designing a semi-commercial plant.

Asarco Associated With Mexican Zinc Plant

American Smelting & Refining Co. and a group of Mexican partners have joined to form Zinc Industrial S. A. The new firm will be the first Mexican producer of high grade zinc used for diecasting and expects to ready a new refining plant at Tlalnepantla, near Mexico City, by the end of 1959 or early 1960. First refining facilities will use as raw material prime western grade zinc, produced at Asarco's Rosita smelter, in Coahuila.

Turnabout: Good Demand for All Base Metals

Copper is firm at 31½¢ a lb, lead consumers are buying at large volume at 12¢, and zinc sales are growing even stronger at the current 11¢ price—all good news to base metal producers who long have fretted over the supply and sales of their metals. Much of the upstep in demand can be laid to subnormal consumer inventories and short metal supply due to output curtailments and small stocks of scrap metal.

Oliver Iron Mining Takes 27 Safety Awards

A number of national safety agencies have awarded U. S. Steel's Oliver Iron Mining Div. with 27 prizes for its fine safety record in 1958. Lost-time accidents were cut by 61 pct over 1957. Frequency rate was 2.44 accidents per million man-hours.

Coal Waste Plant to Produce Chemicals?

If all goes as planned General Dynamics Corp. and Philadelphia & Reading Corp. will build a plant using the Lurgi process to produce electricity and bulk chemicals from coal waste. They would form a company called Dynamics Reading Chemicals Inc. as the start of a large chemical complex in eastern Pennsylvania that would turn out acetylene, ammonia, urea, and vinyl chloride. Raw material is available: P & R produces some 350 million tons of coal waste annually. But there are problems: customers must be signed before plans move into action and the projected products are now in oversupply.

AEC Calls for Uranium Reserve Data

Uranium mine owners have been requested by the AEC to supply information on ore reserves developed as of November 24, 1958. The data must be submitted before August 1, 1959, by those who wish to be considered in negotiations for uranium concentrate procurement for the 1962 to 1966 period.

First Western Canada Iron & Steel Smelter

Consolidated Mining & Smelting Co., of Canada Ltd. is building Western Canada's first iron and steel smelter. The smelter, at Kimberly, B. C., will be the first stage in an integrated iron and steel operation costing more than \$20 million. Facility will produce pig iron, steel ingots, and rolled steel products. Capacity: 100,000-plus tons yearly.

Eldorado Mining Spurs Marketing Drive

Canada's government-owned Eldorado Mining & Refining Ltd. has plans for developing foreign markets for its uranium. Uranium no longer is in under-supply and, like other boom products that forge ahead tremendously on the production level, it has reached the point where aggressive salesmanship is now needed. In addition to promoting sales, Eldorado is resuming exploration in the Great Bear Lake region and is spending a large sum on surface and airborne geophysical study of an area near Port Radium.



metal mining modernization

Savings by the second

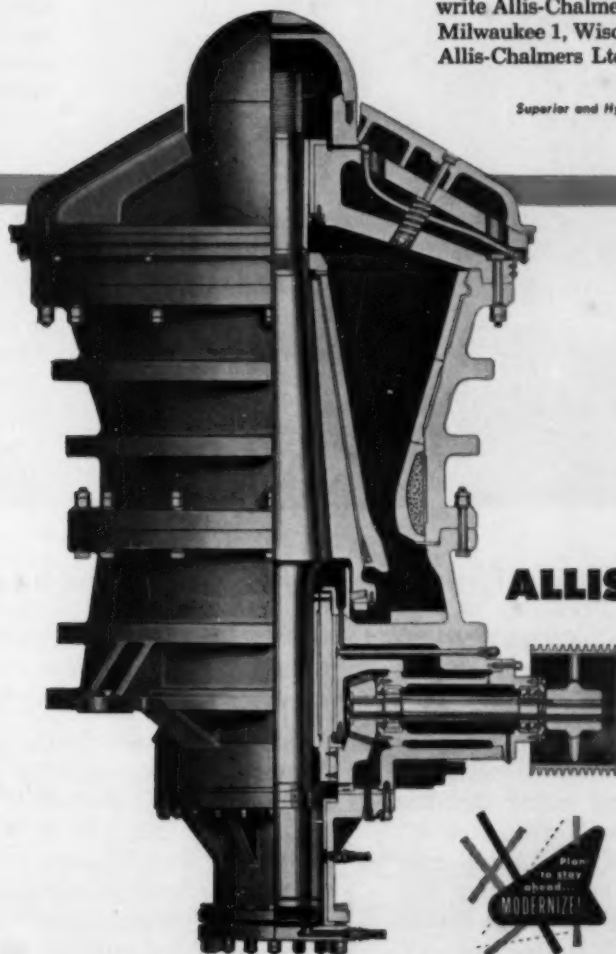


**Adjusting for wear is a
one-man, one-minute operation
on Superior crushers**

Even on the largest *Superior* crushers, the time it takes to change settings is measured with a stop watch — not a calendar. The secret is *Hydroset* control. Flip a switch, it's that easy. Remarkable *Hydroset* control also facilitates emergency unloading. Remember, only Allis-Chalmers gyratory crushers offer this profit-building speed and convenience.

Bulletin 07B7870 tells the complete *Superior* crusher story. Get a copy from your A-C representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin. In Canada, write Canadian Allis-Chalmers Ltd., Box 37, Montreal, Quebec.

Superior and Hydroset are Allis-Chalmers trademarks.



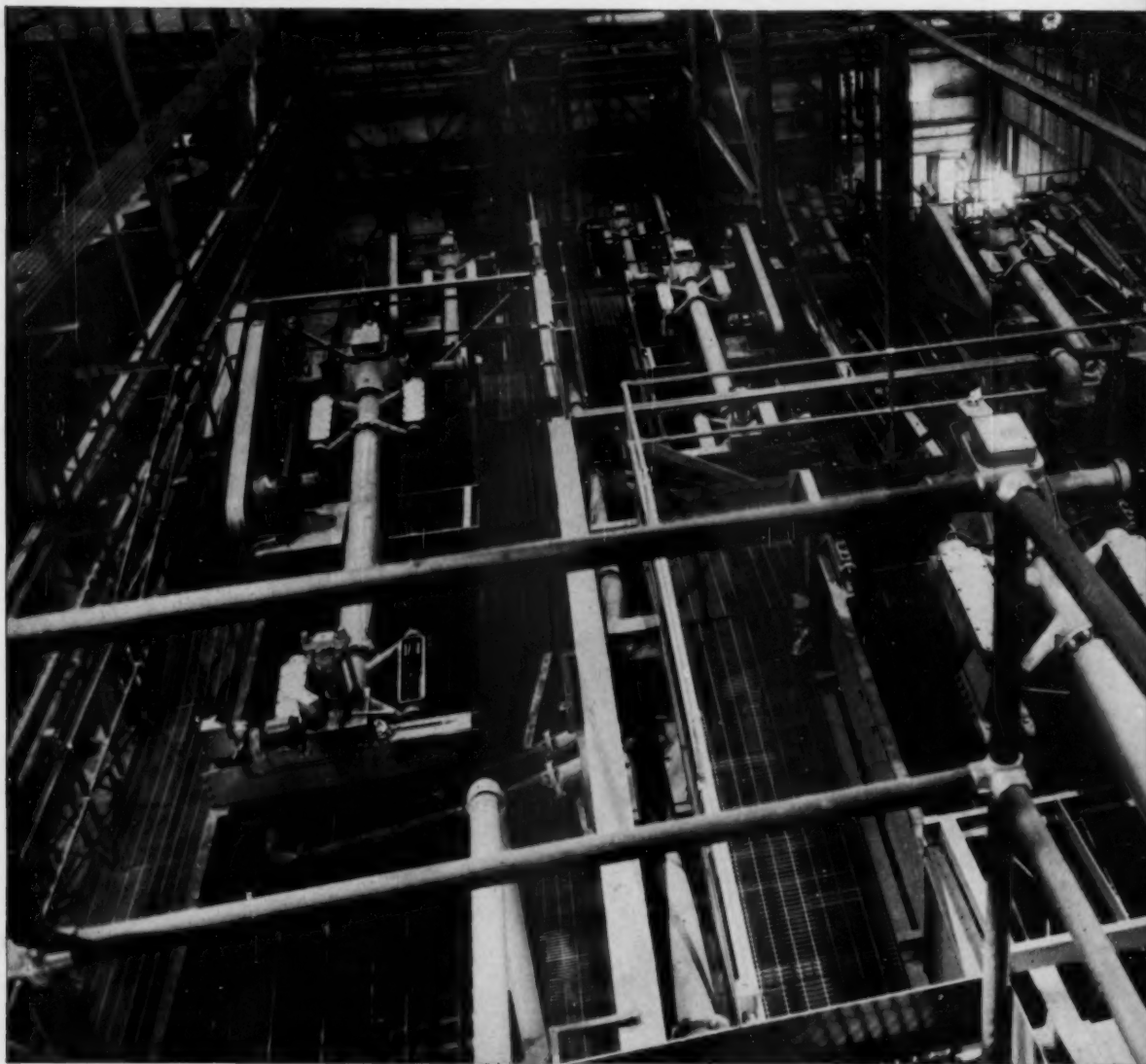
ALLIS-CHALMERS



A-5933



THICKENING AND CLASSIFICATION IN



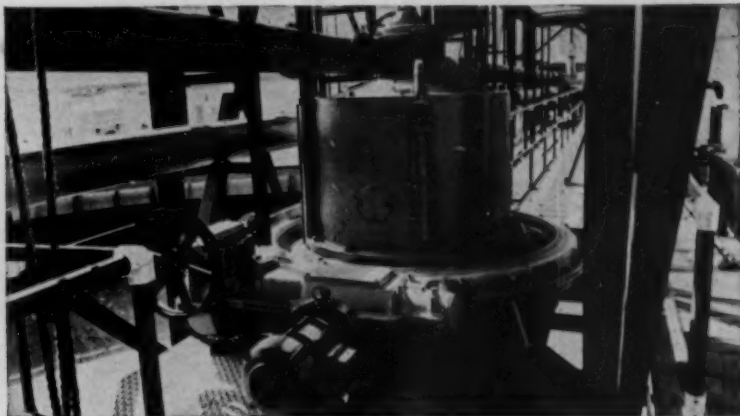
Kermac Nuclear Fuels Corporation uses Dorr-Oliver equipment in giant New Mexico operation

The 3,300 TPD acid leach uranium mill of the Kermac Nuclear Fuels Corporation ranks as one of the most spectacular operations in the huge uranium ore processing center that has grown up in the Grants, New Mexico, area.

A feature of the mill is its use of heavy duty Dorr-Oliver equipment in the thickening and classification circuits. The six Dorr C.C.D. Thickeners installed, each 120' in diameter x 17'

C.D., with rubber covered underwater parts and stainless steel blades, are the largest center shaft or overhead suspension type thickeners ever manufactured. Underflow from the thickeners is handled by batteries of Dorrco rubber lined duplex diaphragm pumps, three for each thickener. Sand-slime separation is made at 100 mesh by hydraulic cyclones, and the sands are washed in two parallel circuits with a total of ten Dorr

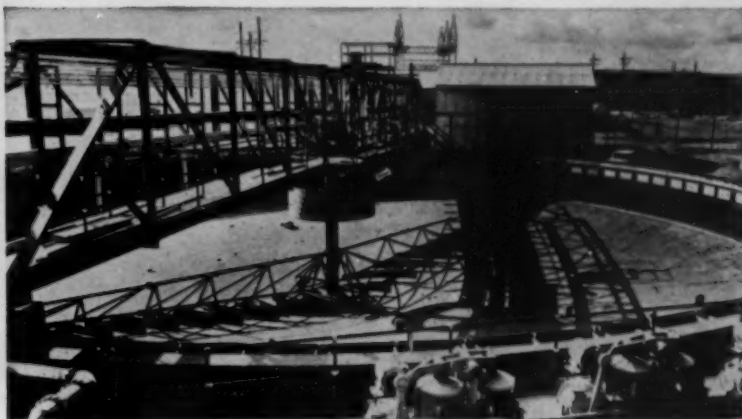
3,300 TPD ACID LEACH URANIUM MILL



▲ DORRCO THICKENER DRIVE HEAD shows massive design. This unit features balanced double reduction worm gear and motorized lifting device to lift thickener rakes 24 inches.

◀ C.C.C. SANDS WASHING CIRCUIT includes ten Dorrco rubber lined Classifiers, each 6' wide x 33' long. Photo shows arrangement in two parallel circuits.

DORRCO COUNTER-CURRENT DECANTATION THICKENER, 120' diameter, is one of six installed in the "B" circuit. Also shown in this photo are the Dorrco rubber lined duplex diaphragm underflow pumps, three of which are used with each thickener.



rubber lined classifiers, each 6' wide x 33' long. Classifier blades are stainless steel.

The know-how behind each unit of Dorr-Oliver equipment is based on more than half a century of world-wide experience in metallurgical proc-

essing. Whether your requirements be for individual equipment or a complete design and consulting service, D-O can be of help to you. For complete information, write to Dorr-Oliver Incorporated, Stamford, Connecticut.

Dorrco—Trademark of Dorr-Oliver Inc., Reg. U. S. Pat. Off.



ONE GOING...



ONE COMING...

ONE
LOADING...



Bucyrus-Erie
BALANCED
ENGINEERING

keeps trucks on the move

How can you be sure of high production? Consider this: *more quarry and mine operators depend on Bucyrus-Erie electric shovels than any other.* Performance on the job proves that they are more rugged, stay on the job longer, require less service and maintenance.

Behind this kind of performance is Bucyrus-Erie *Balanced Engineering*... engineering that makes sure that all components are soundly designed, soundly built. The voltage control system is an example. It delivers fast acceleration and deceleration the instant

you need it... gives you high torque at low speeds, high speeds at low torque... and is designed to be consistently dependable.

For the complete story on *Balanced Engineering*, write Bucyrus-Erie Company, South Milwaukee, Wisconsin, Dept. 2LE.

Bucyrus-Erie means...

Balanced Engineering

BUCYRUS
ERIE®

Ed.'s Note:

This is only one report from one school, but like it or not people are a commodity and starting salaries across the nation have been fairly uniform in the past. This release probably marks a trend toward better recognition for mining engineers, through shortage or otherwise. We will let the release speak for itself.

Starting Salary Increase Noted for Mining Engineers

Average starting salaries for mining engineering graduates this June at Lehigh University are up 12 pct over last year.

A report released by Everett A. Teal, director of placement and counselling at Lehigh, reveals that the mining engineering graduates' average starting salary was increased from \$438 in 1958 to \$490 this year.

The average salary for the entire 1959 class, including all curricula, was up 4 pct to \$474.

The seven seniors sat for 24 interviews by personnel men from 14 different companies. A year ago 17 companies sent recruiters to Lehigh and conducted 23 interviews with five mining engineering seniors.

Candidates for jobs with degrees in engineering physics received the top average monthly salary, with a jump from \$470 in 1958 to \$525 this year.

In his analysis of basic starting salaries accepted by this year's graduates, Teal points out that the average starting salary for all engineers will be \$493 compared to \$474 a year ago.

Those who received diplomas from the College of Business Administration found the ante raised from \$412 in 1958 to \$427 now. A boost of \$25 from \$381 to \$406 is reported for graduates of the College of Arts and Science.

Teal's report reveals that 16 more companies sent representatives to the Lehigh campus in 1958-1959 than a year ago. Personnel men from 312 companies held 6988 interviews with the seniors.

The report on starting salaries for Lehigh seniors this year compared to 1958 follows:

1959 Lehigh University Senior Placement Salaries

	1959	1958	Increase or Decrease	Per- cent
Arts	\$406	\$381	\$25	+ 7
Business Administration	427	412	13	+ 3
ENGINEERING				
Chemistry	460	485	-25	- 5
Chemical Engineering	486	477	9	+ 2
Civil Engineering	470	459	11	+ 2
Electrical Engineering	515	485	30	+ 6
Engineering Physics	525	470	55	+12
Industrial Engineering	481	470	11	+ 2
Mechanical Engineering	490	474	16	+ 3
Metallurgical Engineering	490	486	4	+ 1
Mining Engineering	490	438	52	+12
TOTAL ENGINEERING	493	474	19	+ 4
Average Salary for Class	474	455	19	+ 4

Ad Series by Engineers Joint Council to Help Clear Confusion Over "Engineer"

"Scientists make it known, but engineers make it work!" This is the theme of a series of public service advertisements by Engineers Joint Council now appearing in *Editor & Publisher*, business magazine for the newspaper profession. The ads are designed to create desirable understanding of engineers and engineering by printed media, radio and television, public officials, organizations and advertising agencies.

Carrying such titles as "Let's Get Clear On What Engineers Do," "Just Who's Firing Those Missiles," and "Say Engineer When You Mean Engineer!" the ads may help news writers and editors present to the public a better picture of the engineer and what he does. They also will help clear up existing confusion between "scientists" and "engineers", terms frequently used interchangeably.

According to Enoch R. Needles, president of Engineers Joint Council, which represents 350,000 of the nation's engineers, "The engineer's hand touches every material thing used by the consumer to make his life a happier one. Our expanding economy is an engineered economy, and it is high time people realized their obligation to recognize the men and women who are making it possible.

"We, at Engineers Joint Council, hope that our advertising program on behalf of all engineers will help to bring home to thoughtful persons the important place of the engineer in today's world. We further hope that reporters and editors will find the information in the ads helpful to them in putting the engineer in proper reference in the news stories of our advancing technology."

EJC, in each of the ads, offers itself as a source of information and reference on the broad aspects of the engineer's responsibility, his education and his work. EJC prepares timely and accurate reports on such matters as engineers salaries, number of engineering graduates, number needed and opportunities for engineering teachers.

The first ad appeared in *Editor & Publisher* on June 20. Subsequent ads will appear at intervals throughout 1959. Below is a sample.

One of a series

**Let's get clear on—
WHAT ENGINEERS DO**

Simply stated, engineers apply the sciences to give people use of nature's materials, forces.


Scientists make it known. Engineers make it useful.

Scientists split the atom; engineers design and build the atomic power plants.

All science known would benefit nobody if not applied by engineers to manufacturing, construction, mining, agriculture or the generation of power.

These are the great engineered industries—all based on scientific knowledge.

Engineers plan, design, produce, maintain and operate. To repeat: Scientists make it known. Engineers make it useful.

 **Engineers Joint Council**
29 West 29th St., N. Y. 18, N. Y.
For information call Pennsylvania 6-9229

"READY-TO-USE" DYNATEX* COSTS LESS THAN PRILLS

Extensive tests conducted in open-pit mines and quarries have shown that Dynatex produces rock or ore at a lower cost than prilled ammonium nitrate-fuel oil mixtures.

These tests, conducted under actual working conditions, proved that Dynatex permitted an increase in the distance between drill holes as well as an increased burden. Economies were effected all along the line. The explosives loading factor was reduced, as were loading time, labor, drilling, and blasting costs.

If you have, or are now using, a prilled ammonium nitrate-fuel oil mixture, be sure to test Dynatex on your next blast. Our technical representatives will be glad to show you how Dynatex blasting agent can cut your costs, too. Phone or write our nearest branch office for complete information.

NO FUSS—NO MUSS. No mixing on the job—Dynatex is delivered ready for use.

QUICK LOADING. In cartridges, Dynatex is quickly loaded into bore holes. Where conditions permit, Dynatex may be poured into bore holes.

UNIFORM STRENGTH AND QUALITY. Dynatex is a blasting agent of uniform known strength and dependability.

CHOICE OF PACKING. Dynatex is available in multiwall paper, special burlap or Flexo-Bag® containers, or in fiber drums of standard diameters.

*Hercules trademark

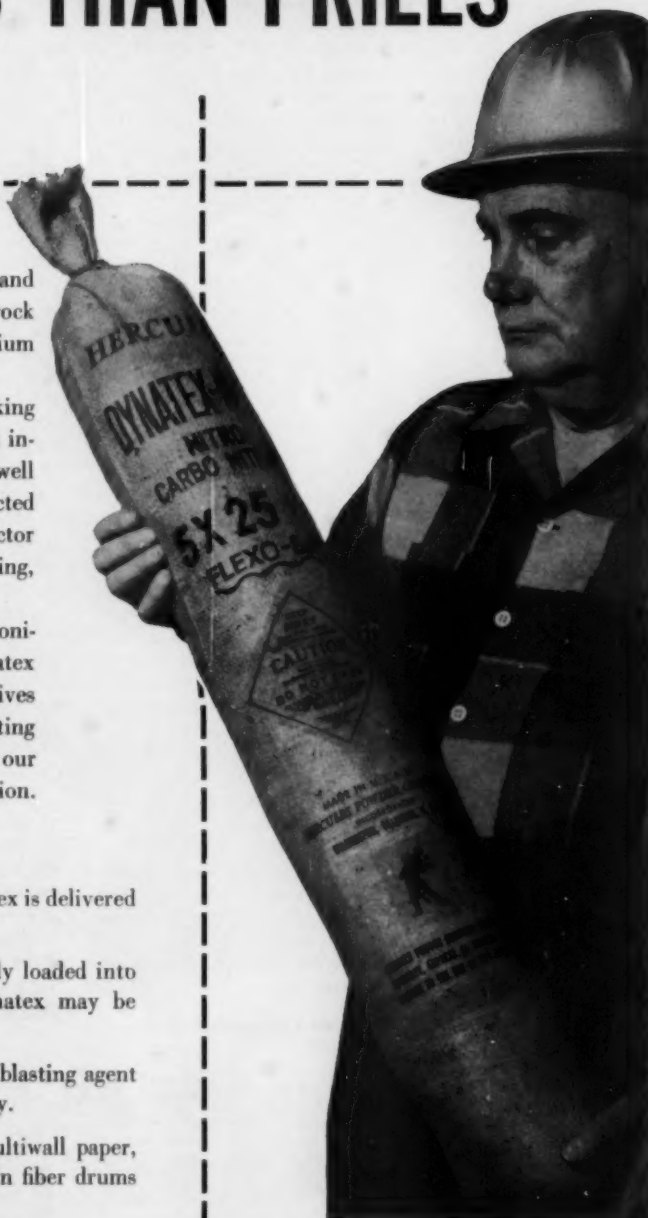


Explosives Department
HERCULES POWDER COMPANY

INCORPORATED
900 Market Street, Wilmington, Delaware

Birmingham, Ala.; Chicago, Ill.; Duluth, Minn.; Hazleton, Pa.; Joplin, Mo.; Los Angeles, Calif.; New York, N. Y.; Pittsburgh, Pa.; Salt Lake City, Utah; San Francisco, Calif.

674—MINING ENGINEERING, JULY 1959



HERCULES



THE UNDERGROUND DIAMOND DRILL WITH HIGHEST TORQUE THE JOY 25

High torque in the new Joy 25 drill gives twice the rotating power of any drill in its class . . . faster penetration in any formation.

A 14 HP turbine air motor supplies the high torque through a planetary gear reduction. This power, plus a choice of maximum bit speeds from 435 to 1000 rpm, permits matching the machine to each job with utmost economy. With four rates of advance for each bit speed the driller can select the highest practical rate of bit advance for longer bit life. A new feed gear shifter changes feed rate smoothly, instantly, while the drill is rotating, and a simple friction brake permits fast retraction of the feed screw with complete safety.

The Joy 25 drills deep . . . to 625 feet with EWX fittings and 500 feet with AWX fittings. Optional equipment available with the Joy 25 drill includes choice of single-column or double-column mounting, pneumatic rod puller, (shown in picture) water pump and a complete line of drilling accessories. Get complete information on this new core and blasthole drill. Contact your Joy representative or send for bulletin 315-7.



EQUIPMENT FOR MINING...FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

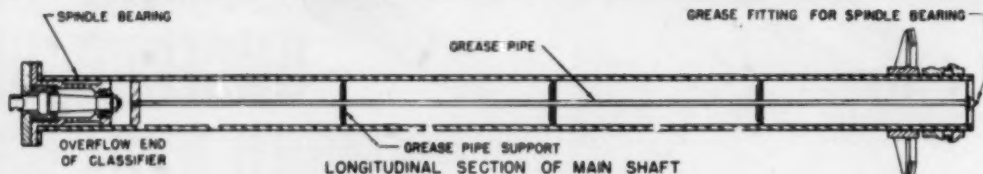
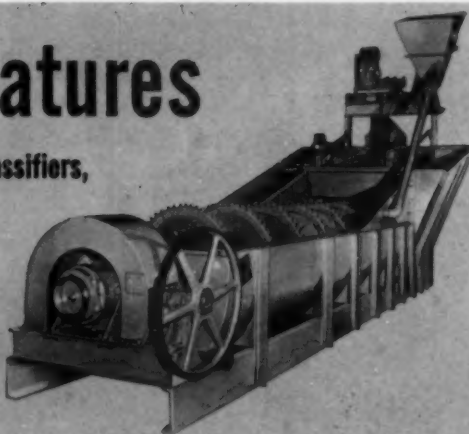
In Canada: Joy Manufacturing Company
(Canada) Limited, Galt, Ontario

WSW M7670-015

Exclusive Akins Features

which assure low-cost, trouble-free operation of classifiers, heavy media separators and densifiers

50 years of experience in the design, manufacture, and operating performance of spiral classifiers, heavy media separators and densifiers, has proven the importance of the exclusive mechanical features of the Akins machines... importance in terms of metallurgy, and in the economy of long, trouble-free operating life with minimum maintenance.

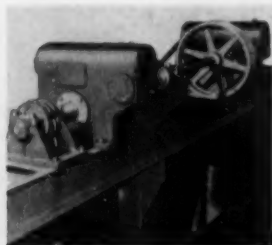


SUBMERGED BEARING

The patented submerged bearing has proven its advantages of durability, trouble-free operation, and ease of maintenance.

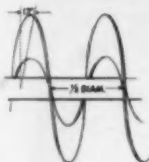
LUBRICATION

The submerged bearing is grease-gun lubricated through a pipe in the main shaft; thus the pipe is isolated from tank contents and protected against breakage. Grease fitting is at upper end of shaft for maximum convenience.



MECHANICAL LIFTING MECHANISM

The lifting device consists of chains, chain sprocket sheaves, and motor-driven or hand-operated reducer unit. Experience has proven this mechanical arrangement to be the most positive, with no possibility of slippage. Minimum maintenance. No packing glands or rods to become worn.

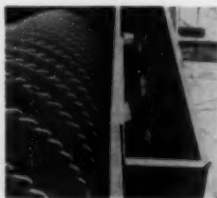


SPIRAL PITCH

50 years of experience has shown that the half-diameter pitch gives maximum raking capacity and results in less slippage and less wear than advanced pitch spirals.

WEARING SHOES

Wearing shoes are made of various alloys, including Climax 42-A. Patented serrated wearing shoes are available for special applications. Special inner shoes are provided for heavy rake loads.



DRIVE

The bevel gear, V-belt drive has proven to be the most trouble-free and flexible. It permits mounting the motor, or motor-reducer, horizontally, and changing speeds quickly and inexpensively, by simply changing V-belt sheave ratio.



TANK SUPPORTS

Web beam substructure supports tank. There's no load to be carried by tank. This also reduces installation cost by eliminating need for extra sub-structures to support tank.



OVERFLOW BOX

An overflow box, with a pipe connection, is furnished as standard... requires only a single connection.



For complete information
on Akins machines write
for catalogs.



Manufacturing Division

MINE AND SMELTER SUPPLY CO.

DENVER 16
3800 RACE STREET

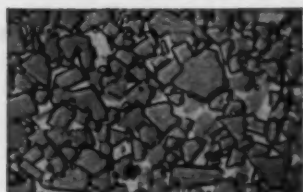
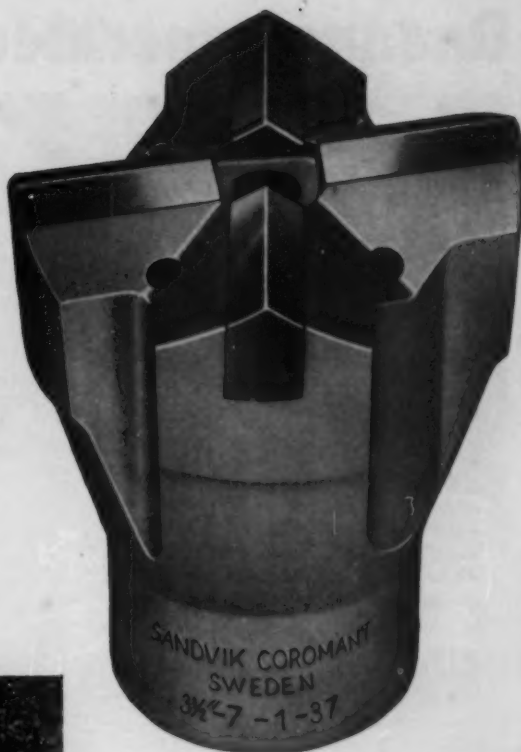
NEW YORK 17
122 E. 42nd STREET

SALT LAKE CITY 1
121 W. 2nd S.

EL PASO
1515 11TH AVE.

Licensed Manufacturers and Sales Agents in Canada, Australia, Sweden, England, South Africa
Sales Agents in Peru, Chile, Philippine Islands, Japan, New York City (for Continental Europe)
and in principal cities of the United States.

Longer bit life— with *new* Sandvik Coromant Bits



Sandvik Coromant Tungsten Carbide
(Microphoto) Uniformity of size, even distribution of grain are marked. Free from porosity and impurities—therefore stronger, longer-lived.



Low quality Tungsten Carbide
(Microphoto) Black marks are contaminations caused by deficient production control. They weaken the carbide, reduce its working life.

Sandvik Coromant Detachable Bits are Available in the following Thread Sizes and Bit Diameters

Available Diameters, in inches

Type	Thread	1 1/8"	1 1/2"	1 3/4"	1 7/8"	2"	2 1/8"	2 1/4"	2 3/8"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"
SHOULDER	TAPER	x	x	x	x										
	F		x	x											
	113		x												
	H			x	x	x	x	x	x						
	115			x	x										
	D					x	x	x	x	x	x	x	x	x	x
BOTTOMING	K											x	x	x	x
	1" Rope			x	x	x	x	x							
	1 1/4" Rope					x	x	x	x	x					
	400					x	x	x	x						
	1 1/2" Rope								x	x	x	x	x		
	600								x	x	x	x			
	700										x	x			
	17.5												x	x	
	2" Rope											x	x	x	x
	1000												x	x	

NEXT time you buy bits, specify Sandvik Coromant because they give more footage per bit, lower drilling costs. Here's why:

- 1 Only first-quality tungsten carbide is used—as shown in the microphotos above. This means less wear, longer life and a better job.
- 2 The bodies are precision-made of high quality alloy steel—tough enough to take the strain throughout the extra-long bit life.
- 3 The bigger Sandvik Coromant bits are all of X-design, which prevents rifling. No wonder Sandvik Coromant inserts are the most widely used in the world, drilling more than one billion feet every year.

SANDVIK COROMANT bits are supplied through Atlas Copco, the world's largest manufacturer of rock drills, who also supply Sandvik Coromant integral steels—the most widely used in the world—and Sandvik Coromant extension steel equipment.

Write or phone today for further details to either of the addresses below:

610 Industrial Avenue
Paramus, New Jersey
COlfax 1-6800

Atlas Copco

930 Brittan Avenue
San Carlos, California
LYtell 1-0375

One man operated GISMO® Transloader

- . . . with round-trip travel 1,600 feet
- On shorter hauls tonnage ranges up to 2-tons a minute.
- On longer hauls, tonnage ranges down to 1-ton a minute.

This HIGH tonnage production is accomplished by:

One Man

One S-D Gismo Transloader

How can one man and one piece of equipment do so much work? Because the Sanford-Day Gismo Transloader is BOTH a mucking-machine and a truck ALL-IN-ONE!

It is a high-speed transport — up to 20-miles per hour either direction! The fact it self-loads enables you to completely eliminate idle time of both men and equipment! Therefore, less capital investment required for additional equipment and manpower to do the job.

In conventional loading of materials, the loader is dependent on auxiliary equipment such as truck or shuttle car, etc. The loader cannot operate without the auxiliary conveyance. Neither does the haulage system operate while being loaded. Thus idling of men and equipment.

Compare this with the S-D Gismo Transloader. When Transloader is operating, man and equipment are working all the time; either mucking or transporting to dumping point! NEITHER THE TRANS-LOADER NOR ITS OPERATOR ARE EVER IDLE! They are continuously at work in uninterrupted cycles!

Visualize one or several S-D Gismo Transloaders, each with only one man, MUCKING AND HAULING in your development or production work. Savings are tremendous! Write or call us today. Manufactured by Sanford-Day Iron Works, Inc., Knoxville, Tenn.



This photograph catches the action of the S-D Gismo Transloader mucking out a load.

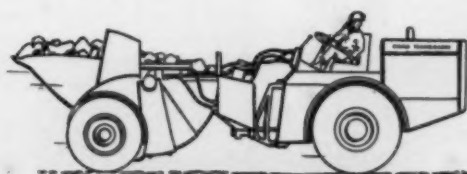
Conventional Method



Transloader Method



LOADING



TRANSPORTING

"Mucks-Hauls-Dumps" 100-tons an hour!



Here you see S-D Gismo Transloader with large, wide dipper down under hard rock. Transloader makes its own roadways and cleans-up completely . . . also moves large boulders for secondary blasting.



. . . and here is dipper raised with full load. This high-powered, high-speed Transloader operates on grades, in favor or against the load . . . negotiates, turns, etc.



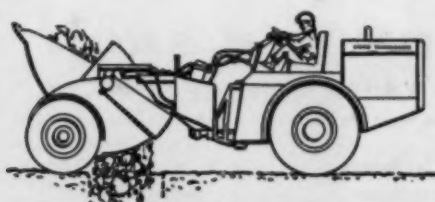
This tramming scene (on way to raise) shows S-D Gismo Transloader as truck-transport.



Here load is being dumped into raise. Transloader also backfills waste, or dumps directly into bin . . . or by simple ramps over trucks, cars, conveyors, etc.

THE GISMO TRANSLOADER, rubber-tired Gismo Self-Loading Transport, is an advanced equipment development that is a perfectly natural result of the performance of the Gismo powered by crawler-mounted tractors developed a few years ago and doing an outstanding job in mechanized mining today!

SANFORD-DAY KNOXVILLE, TENNESSEE



DUMPING

- S-D Mine Cars, all types and kinds.
- Precision S-D Mine Wheels.
- Tough, year-after-year wheel service by special S-D wheel Hard-Facing Process (this can really save you money and eliminate downtime).
- S-D "Brownie" Hoists. • S-D Car Spotters.
- S-D Mine Sheaves and Rollers.
- S-D Slusher-Trains for mining and construction industries.
- S-D Gismo Transloader for mining and construction industries.



for tough grinding problems **KENNEDY** **Ball and** **Rod Mills**

KENNEDY Ball and Rod Mills solve the toughest grinding problems by providing dependable wet or dry grinding at low cost and with minimum maintenance. Consult KENNEDY and learn more about these features that distinguish KENNEDY Grinding Mills:

- Cast steel or Meehanite heads
- Welded and stress-relieved heavy steel plate shells
- Large diameter trunnions
- Self-aligning bearings with adjustable sole plates
- Positive "Ferris Wheel" lubrication of main bearings
- Oil-tight bearing seals
- Motorized hydraulic lift to reduce starting torque
- Single helical cast steel gear and pinion



KENNEDY VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

405 PARK AVENUE, NEW YORK 22, N. Y. • FACTORY: DANVILLE, PA.

Primary & Secondary Gyratory Crushers • Jaw Crushers • Roll Crushers • Impact Breakers • Hammer Mills • Rod & Ball Mills • Kilns
Dryers • Screens • Conveyors • Complete Crushing, Lime and Cement Plants. KENNEDY Research & Testing Services.



CYANAMID

REAGENT NEWS

"ore-dressing ideas you can use"



*Now-
Pelletized
AERO®
XANTHATES*

**dust-free,
easier to handle**

Formed under uniform pressure to approximately $\frac{1}{8}$ " diameter, AERO Pelletized XANTHATES resist degradation in shipping and handling, improve working conditions, dissolve quickly and uniformly. Their higher bulk density means lower transportation costs.

Cyanamid can provide your complete reagent requirements from its long line of Xanthates, AEROFLOAT® Promoters, AEROFROTH® Frothers, AERO® Depressants, AERO® Brand Cyanide, AEROFLOC® Reagents and AEROSOL® Surface Active Agents. Combination shipments from plant or strategically located warehouse stocks can still further reduce your delivered cost, minimize your inventory and simplify purchasing.

And as an additional plus-value, the reagent application services of Cyanamid Field Engineers and the Cyanamid Mining Chemicals Laboratory are always available to Cyanamid Customers.

AMERICAN CYANAMID COMPANY

EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

CYANAMID INTERNATIONAL—Mining Chemicals Department
Cable Address:—Cyanamid, New York

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

CYANAMID OF CANADA LIMITED
140 Bloor Street East,
Toronto 2, Ontario, Canada

CYANAMID DE MEXICO, S.A.
Esmeralda Postal 222
Mexico 1, D.F., Mexico

CYANAMID OF GREAT BRITAIN LTD.
Bank House, Abingdon, London W. C. 2, England

SOUTH AFRICAN CYANAMID (PTY.) LTD.
P. O. Box 1222,
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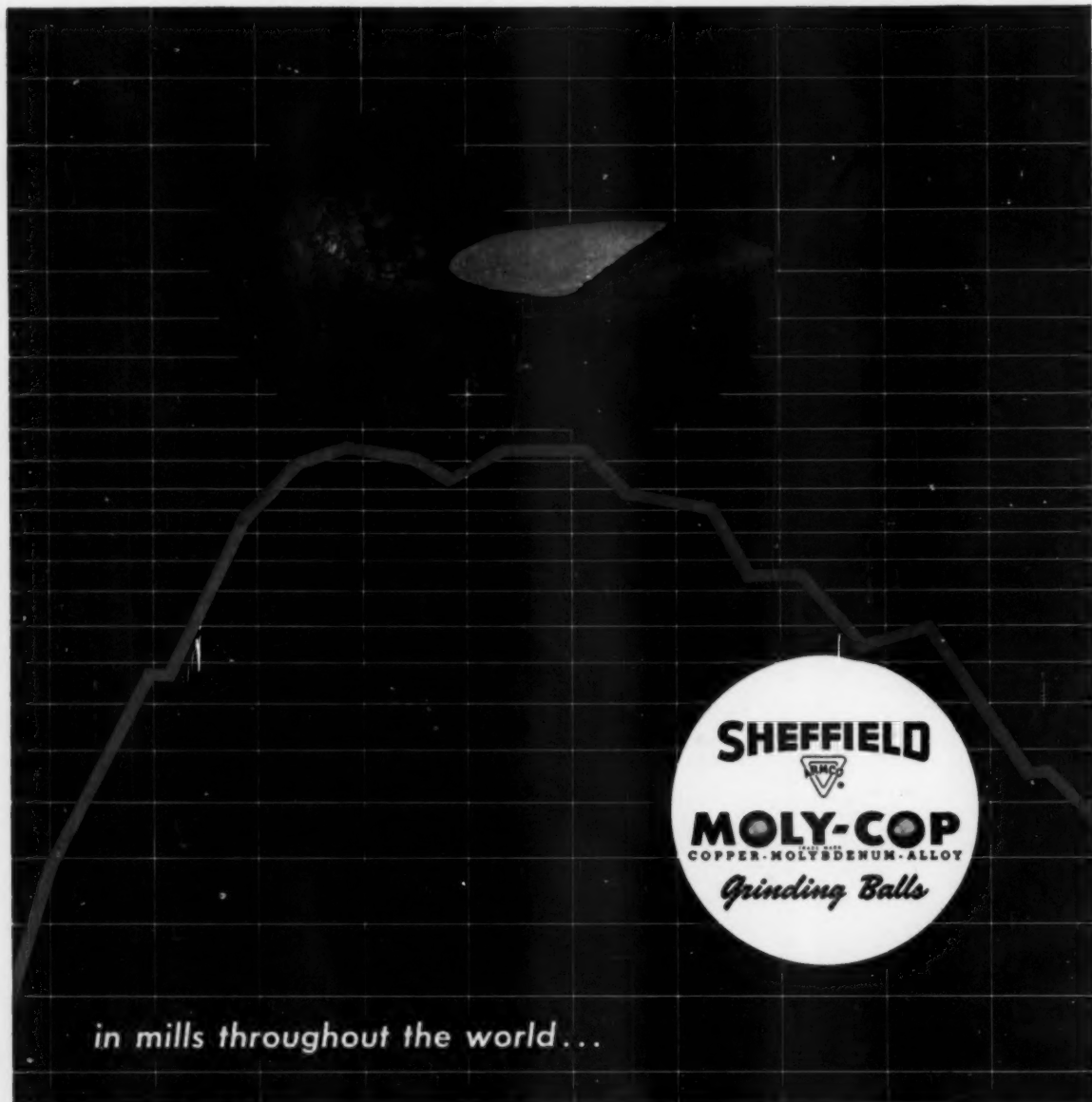
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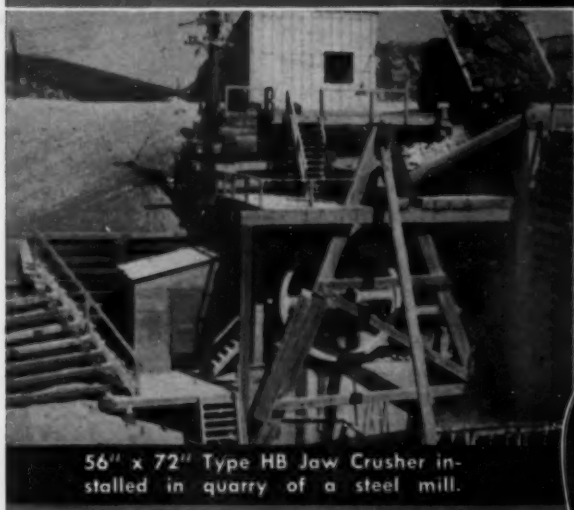
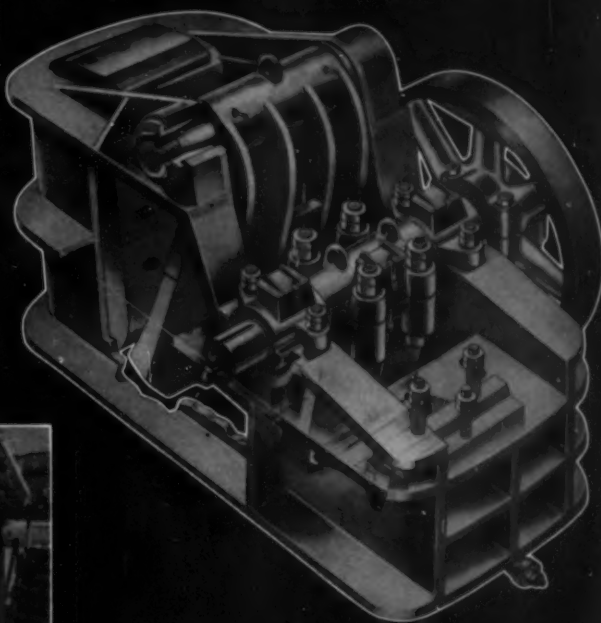


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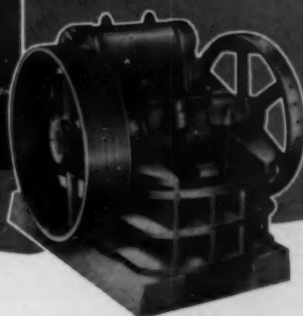
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SME MEMBERSHIP DIRECTORY

Bound into this issue (detachably) is an alphabetical and geographic-company directory of the members of the Society of Mining Engineers of AIME. An innovation both for SME and for MINING ENGINEERING, the directory issue meets many requests, and enables the Society to send the directory material of greatest use to all its members. SME plans to make this directory issue an annual feature.

There will be no overall AIME directory this year, since each constituent Society is publishing a directory of its own members in its own journal. But, provision has been made for those who need or want a directory of all AIME members and who do not want to keep loose copies of the three journals. A special binder has been stocked, designed to hold the three Society directory sections. A picture of the binder, descriptive material, and an order form appear on page X of the directory section.

Separate copies of the SME directory section are available for \$1.00 each from the AIME Order Dept. Copies of the directory of The Metallurgical Society (*Journal of Metals*, July issue), and the Society of Petroleum Engineers (*Journal of Petroleum Technology*, June issue) are also available for the same price from the same source.

We believe that the typography of the directory section offers better readability than the last AIME directory. Running headings were also added to all pages for better findability. Listings are corrected to include changes received up to April 15th. Company affiliations are based on response to the card mailed to all AIME members early this spring. If you find your affiliation omitted, please think back as to whether you mailed in that directory card ... about 30 pct did not.

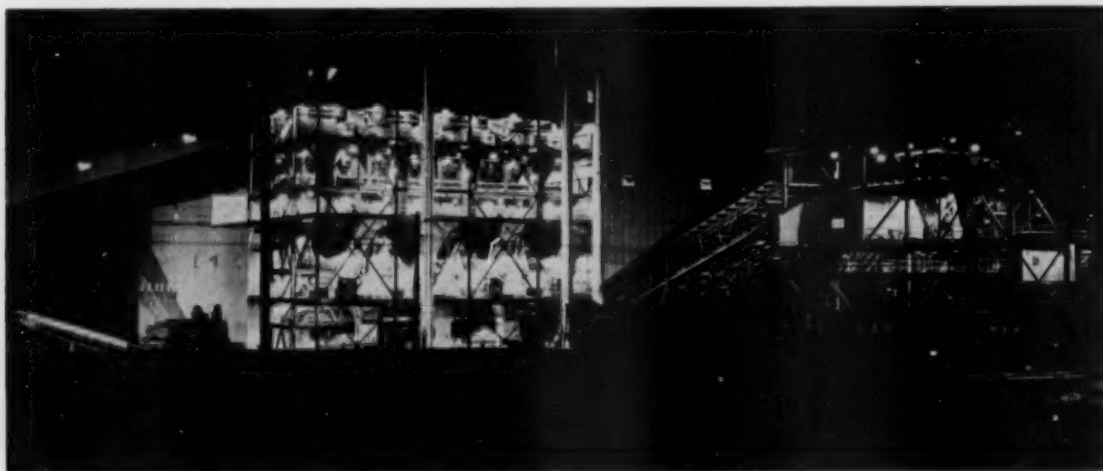
MINING ENGINEERS ON THE MOVE

At the All-Institute session at the February Annual Meeting, mining engineers were told they might be turning to resources on the ocean floor. Now we have a report from the ASEE meeting in Pittsburgh that "... it is not improbable that we will get rocks and minerals from other planets for processing on this earth." (Those who read *Drift* in the January issue of ME will recall that SME is already getting set for this latter development.)

Mining engineers should be able to take both these developments in stride—they have long proven their adaptability to extremes of environment, including climate, geography, deep underground conditions, and high altitude—and perhaps their adaptability is finally being given proper value. We refer to the report from Lehigh University that starting salaries for graduating mining engineers are up! See *Trends* (p. 673) for the details. —Rixford A. Beals.

MOSS NO. 3 MINE'S NEW COAL PREPARATION PLANT

One of the richest virgin seams of high quality metallurgical coal is now being mined at the Pittston Co. Moss No. 3 mine. By the end of 1959 it will be producing at the rate of 5 million tons a year. A huge new automated preparation plant helps make it possible.



The rich Tiller seam in southwest Virginia averages 10 to 15 ft in thickness. But because it is separated into two benches, mining engineers for years considered it neither physically nor economically feasible to mine. Profitable recovery of this coal has been made possible only by: full-seam mining with automatic machines; and the largest and most highly automated coal preparation plant of its kind—a plant ten stories high which washes, screens, and dries at the rate of 1500 tph, and produces both metallurgical and steam coal products.

The Moss No. 3 preparation plant of Clinchfield Coal Co. Div. of Pittston Co. is located at Clinchfield, Va., only a short distance from the 450-tph Moss No. 2 plant, and was designed, built and erected by Link-Belt Co.

Feed is brought at the rate of about 22 to 24 75-ton railroad cars per hr. Coarse coal is cleaned in new tank-type heavy media vessels, the fine coal on concentrating tables in four parallel coarse-coal and fine-coal circuits. After cleaning, the coal undergoes additional processing, including crushing, sizing, mechanical dewatering and heat drying before being loaded for shipment.

One man in the main control room has at his finger tips some 90 pct of the plant's operations. Operators at four other control stations handle the

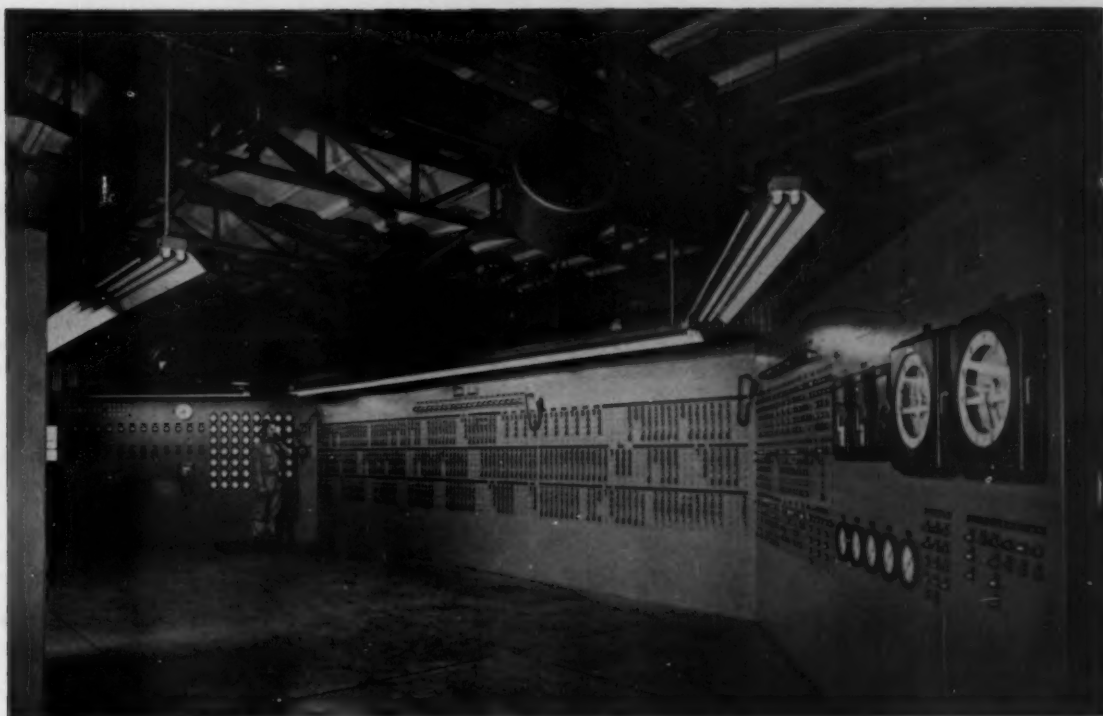
dumping of raw coal from railroad cars, heat drying of fine coal, loading of clean coal into railroad cars, and dumping of refuse in a valley about a half mile away. The plant requires only 16 men per shift, including oilers and mechanics.

Profitable use will be made of what is normally considered waste material. A portion of the shale refuse will provide raw material for lightweight aggregate which will soon be produced in a plant now being built adjacent to the preparation plant.

Process water is circulated at 46,850 gpm. A clarification system recirculates the water in closed circuit, conserving the supply and avoiding stream pollution.

Modern machines and methods employed at the mine and plant are expected to result in production of 45 tpd of coal per man, compared with an average of 11 tpd per man for the coal industry in the U. S., and 1½ tpd in Europe, according to J. P. Routh, chairman of the board of Pittston Co.

Clinchfield properties in Virginia include approximately 300,000 acres, with coal reserves estimated at more than 1 billion tons. Over 100 million tons of recoverable coal have been allocated to the Moss No. 3 mine, assuring a minimum life of 20 years. An additional 100 million tons of the same seam, lying between Moss No. 2 and Moss No. 3, have



Ninety per cent of machinery in Moss No. 3 coal preparation plant is controlled by a single operator in main control room. This 80-ft-long panel contains all pushbuttons, switches, indicating lights and signals for the wet portion of the plant. The operator starts up and shuts down the four parallel coarse and fine coal processing circuits.

been held in reserve for division between these two operations.

This Clinchfield expansion is part of a \$150-million, three-company industrial development program in southwest Virginia. Appalachian Power Co. has built a steam generating plant at Carbo, Va., about three miles south of the Moss No. 3 plant. It will provide 450,000 kw of additional power for the area and will consume some 1.2 million tons of Clinchfield coal each year.

About 900 ft to the north of the preparation plant is the rotary railroad car dumper, with delivery tracks for 302 cars. Belt conveyors connect the dumper house with a crusher house and storage bin, and a long conveyor gallery runs from the base of the bin to the top of the plant.

Operation of Plant: As it arrives from the mine, each 70-ton-capacity gondola car is dumped by the rotary dumper. This unit unloads 22 cars in 45 min of each hour, with the remaining 15 min devoted to switching trains into position.

From a 200-ton hopper beneath the dumper, the run-of-mine coal is carried to the crusher station at the rate of 2000 tph by a 72-in.-wide belt conveyor. Here it is reduced to 4 x 0-in. size, and tramp iron is removed by a belt magnet. The crushed coal is delivered by belt conveyor to a 2500-ton storage bin.

The coal is carried to the top of the preparation plant at the rate of 1500 tph by a 60-in. inclined belt conveyor, and is weighed electronically en-route. It is deposited in a 200-ton surge bin or transferred by another belt to a 600-ton bin.

Coal is reclaimed from the surge bins by four pairs of Syntrol vibratory feeders supplying four pairs of double-deck horizontal vibrating screens.

These screens scalp out slabby rock, remove the $\frac{1}{4}$ x 0-in. coal by wet screening, and pre-wet the 4 x $\frac{1}{4}$ -in. coal.

Coarse Coal Circuits: The 4 x $\frac{1}{4}$ -in. coal from each pair of vibrating screens is collected on a 48-in.-wide oscillating conveyor for delivery to one of four tank-type primary heavy media vessels.

The coal floats across the bath and discharges with its carrying medium over a weir onto screens for draining the free medium back into the system and rinsing the magnetite particles from the coal. As the heavy material sinks it is removed by a double-strand flight conveyor. Sink material is drained in the same manner as the float material.

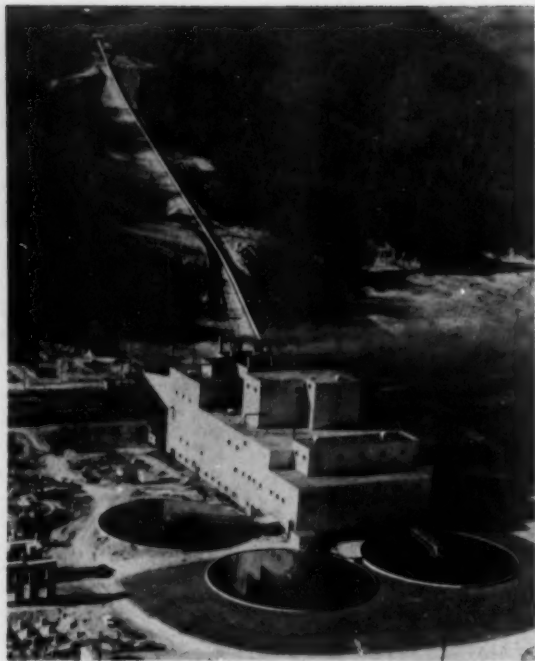
Each primary vessel has an approximate specific gravity of 1.35, producing a float product of clean high quality metallurgical coal and a sink product of refuse and steam coal.

The sink product is fed to four secondary tank-type heavy media vessels with approximate specific gravity of 1.50. The float product of the secondary vessels is steam coal; the sink product is refuse.

A ninth tank-type heavy media vessel will be employed for further separation of the shale refuse which is to be used in production of lightweight aggregate. The balance of the refuse is collected and delivered to the slope belt conveyor for disposal.

The various fractions of clean coal are screened and crushed as necessary to provide the end products desired. Any fine coal in this system is delivered to the heat drying section of the plant.

Fine Coal Systems: Fine coal that passes through the raw coal screens beneath the surge bins and enters the fine coal circuits is pumped from raw coal sumps to eight low pressure cyclones which partially dewater the coal. The fine coal is cleaned



Coal is brought to plant from mine over tracks at right. Refuse is carried to top of hill by conveyor in background and dumped in valley. System is designed for flexibility.

on 32 double-deck Deister concentrating tables, eight for each circuit.

Clean coal from the tables in each circuit enters a drag tank. The $\frac{1}{4}$ -in. x 100-mesh coal settles and is conveyed to 12 centrifugal dryers which serve all four fine coal circuits. The coal is then conveyed to the heat drying section.

Minus 100-mesh material overflows from the drag tanks to one of two 130-ft diam clean coal thickeners which recover fine coal solids and clarify the wash water for re-use. In the thickener the sus-

pended coal settles out and is raked off the conical bottom, while the clarified water overflows and is returned to the plant for re-use. Each thickener has a capacity of 1.9 million gal.

The fine coal solids are pumped to three vacuum filters for dewatering. The filter cake is blended in a paddle mixer with crushed steam coal and delivered to the heat drying section.

Refuse from the tables travels through a single drag tank. The $\frac{1}{4}$ -in. x 48-mesh refuse settles in the tank and is discharged to a dewatering screen and then to a refuse flight conveyor. Minus 48-mesh refuse is flumed to a 130-ft diam thickener which is identical to the clean coal thickeners.

Refuse reclaimed from the thickeners goes to two vacuum filters, and the filter cake is conveyed to the refuse disposal system.

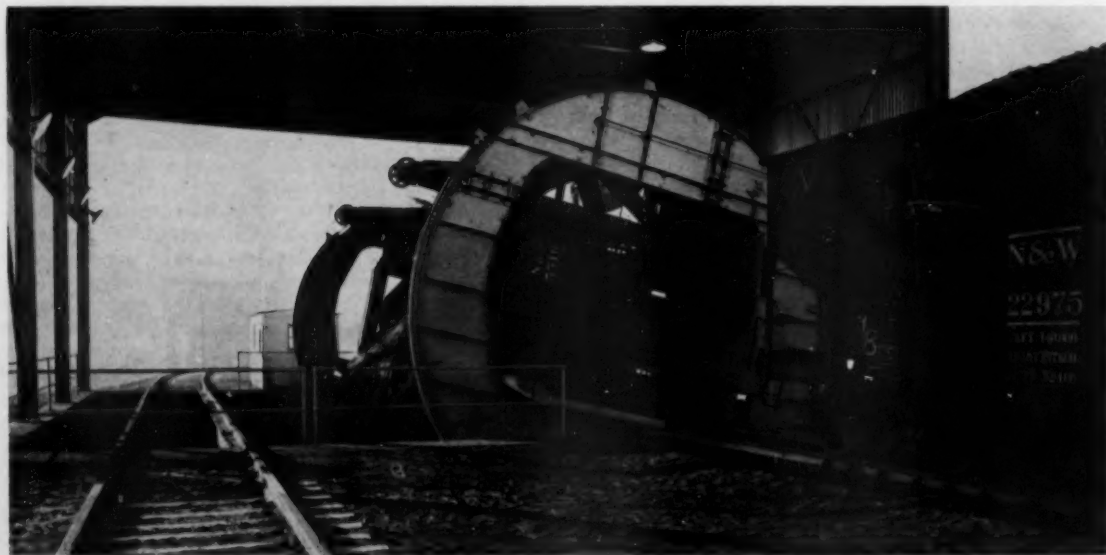
Heat Drying of Fine Coal: Eight Link-Belt Multi-Louvre dryers meet the exacting heat drying requirements for fine coal. Five are normally used to dry fine metallurgical coal consisting of $\frac{3}{4}$ x $\frac{1}{4}$ -in. coal from the heavy media process, together with the centrifugally dried coal from the fine coal system. Surface moisture is reduced to 2 to 3 pct.

The other three dryers are normally used for steam coal, reducing surface moisture to about 5 pct. The dryers are fed from their surge bins by screw feeders with remotely controlled variable speed drives.

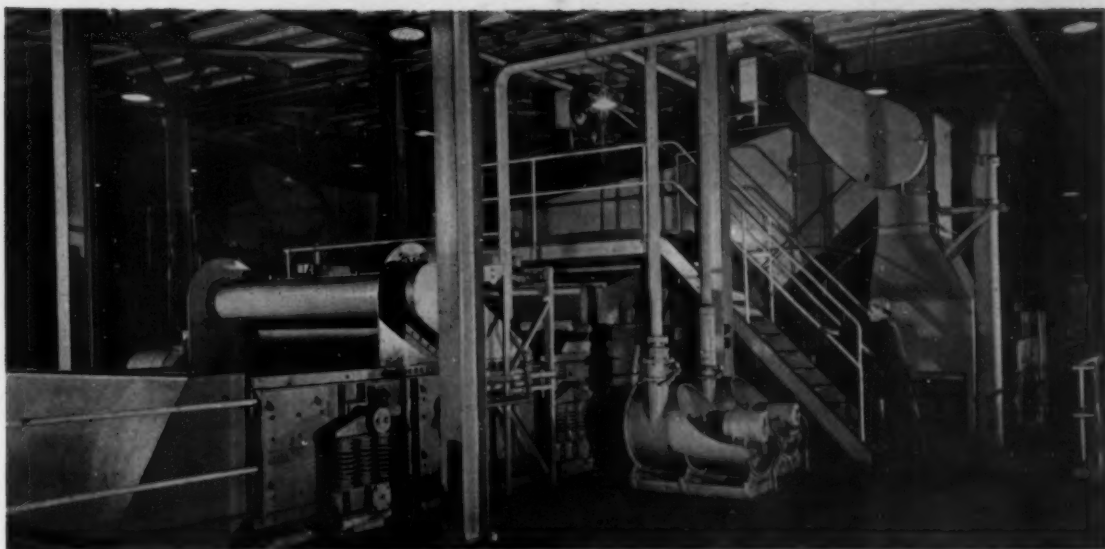
Exhaust gases from each dryer receive primary cleaning in dry dust collectors and final cleaning by wet scrubbers, with dust reclaimed either to dried coal conveyors or the furnace fuel feeder.

Sampling and Car Loading: All coal fractions from the coarse and fine coal systems are collected on four belt conveyors which deliver to five railroad loading tracks. Dried steam coal is normally loaded on track 1 but can also be loaded on track 2. Sized coal is loaded on track 2. Dewatered stoker-size coal is loaded on track 3, and dried metallurgical coal on tracks 4 and 5.

Separate, fully automatic sampling equipment is provided for both the dried steam coal and dried metallurgical coal ahead of the loading facilities.



Twenty-two 70-ton cars are dumped in 45 min of each hour by rotary railroad car dumper, which operates on 60-sec dump cycle. Preparation plant can be seen in distance, to left of dumper. Beneath dumper is a 200-ton hopper.



Clean metallurgical coal float product of each primary heavy media vessel is drained, rinsed, dewatered, and sized by large horizontal vibrating screen (foreground). The sink product, consisting of steam coal and refuse, is conveyed from the tank and discharged onto the double-deck screen at right, and then to the secondary heavy media vessel.

Each system includes a primary cutter, vibratory feeder, sample crusher, and a secondary feeder with cutter.

A common sampling system is provided for the dewatered stoker-size coal and sized coal, consisting of a primary sample cutter for each belt and a common primary sample bucket which transfers the sample to the sampling column.

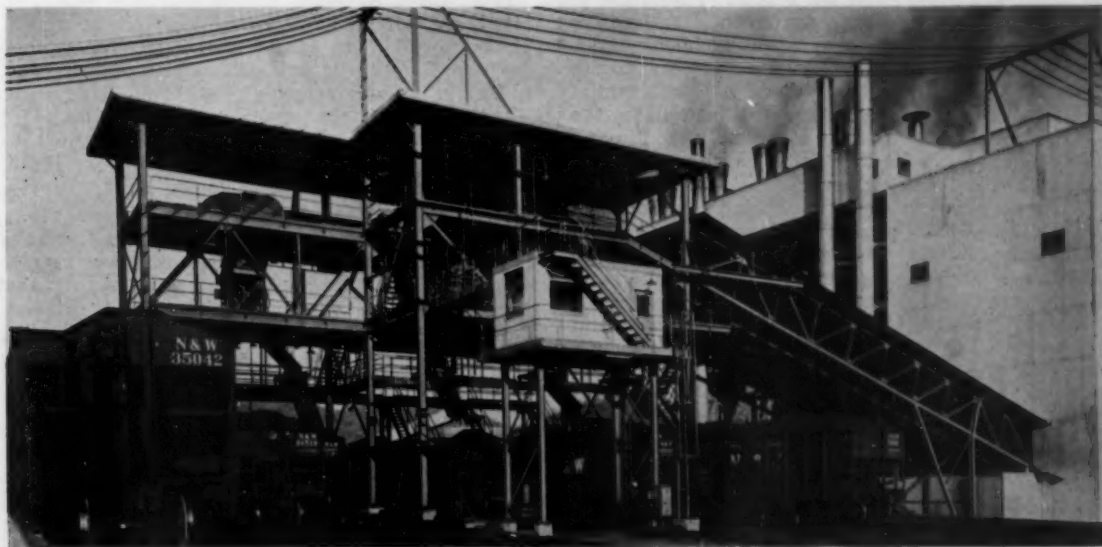
Refuse Disposal System: Rock, shale, and other plant refuse, except for the shale to be used as raw material for the lightweight aggregate plant, is disposed of in a deep valley on the other side of a hill behind the plant. The refuse is collected on a 36-in.-wide belt conveyor which carries it 2400 ft up a slope. The belt is driven by a 400-hp motor through a parallel shaft speed reducer.

An unusual feature of this belt conveyor is an

arrangement by which the belt is turned over after discharging material, so that on the return run the top side of the belt is up. This avoids build-up of material on the return idlers. At the bottom of the run the belt is turned again to its normal position.

The refuse disposal system is designed as a flexible system that can be adjusted as the pile grows. The slope belt discharges to a tower boom stacker which can be rotated in a wide arc and lifted up or down to discharge the refuse in the direction desired.

However, a rail-mounted 36-in. trailing belt conveyor, designed for sectional extension to a maximum length of 600 ft, will be installed in the near future. This conveyor will discharge to a traveling fixed boom stacker which will have a 70-ft radius of swing and a traversing speed of 6 fpm.



At Moss No. 3's shipping area, four belt conveyors carrying dried steam coal, sized coal, dewatered stoker coal, and dried metallurgical coal load to five railroad tracks. Steam and metallurgical coal are first sampled by automated system.



The mobile magnetometer. A modern geophysical instrument.

by **WALTER E. HEINRICHS, JR.**

Since World War II exploration geophysics has derived its scope from the following factors: first, the usual post-war interest in exploration to rebuild war-depleted reserves; second, the impetus supplied by the uranium prospecting boom; third, increased demand for natural resources due to the Korean War; fourth, the discovery of substantial metallic ore by geophysical means in Canada, the U. S., and other countries; and, finally, continuing discoveries of commercial oil by geophysical methods throughout the world.

The past year's national business slump has severely curtailed mining exploration in general and correspondingly has brought about even greater reductions in applied geophysics in mining. Petroleum exploration, conceived and executed on a broader statistical basis than mining, has kept up its geophysical programs relatively well, although domestic work has been substantially reduced.

MINING APPLICATIONS

In mining, the pulse or induced potential gear still seems the best approach to delineating disseminated sulfides. Better and more portable units are giving more consistent data, and continued use of

these instruments is improving the interpretation of results. Different versions of magnetometers with vastly increased performance are now available. Some are self-leveling, and at least one is continuously portable and can be read at any time in any position. Each in its particular application is ideal, but none is universally efficient. General advances in all phases of electronics have materially aided major improvements in all electrical method instruments and have helped promote significant new and improved drillhole techniques. A gravity meter has been developed for use on boats.

One of the most interesting advances in terms of potential use in Arizona is in the realm of natural force field electromagnetics. According to the competent Canadian developers, the equipment perfected for use in the field is less time-consuming and much simpler to use than the artificial force field E. M. gear. This new method is also said to have very deep penetration possibilities, although there may be resolution problems to overcome.

Contrary to hair-splitting legal opinion, the new Federal mining claim assessment law, though too general and far from ideal, will aid the increased use of geophysics both now and in the future. Arizona and several other states, moreover, have recognized geophysics one way or another, either in their laws or regulations. Through further use

W. E. HEINRICHS is President and General Manager of Heinrichs Geoeexploration Co., Tucson, Ariz.

TRENDS IN THE APPLICATION OF GEOPHYSICS

A resumé of the actual situation of geophysics in mining—where, how, for what purposes, and at what costs—based on the current picture of exploration in Arizona.

and experience these legal aspects will be improved and gain wider acceptance.

GENERAL COSTS

Present equipment costs vary from \$25 for a cheap magnetic dip needle to about \$35,000 for a continuous recording magnetometer, electromagnetometer, or surface hydromarine gravity meter. Pulse or induced potential instruments may cost \$10,000 or more and as little as \$1500 or less. Portable gravity meters cost about \$8000. Prices for other electrical and magnetic equipment range from \$100 for small metal detectors, radiation detectors, and complete geochemical kits to \$5000 for good surface electromagnetic and hole-logging gear.

Aerial continuous traverse work costs roughly \$6 per mile per method. Average mobile continuous traversing charges are \$4.50 per mile. Large reconnaissance surveys might run less than \$0.10 per acre, per method, whereas small, accurate detailed surveys can exceed \$200 per acre. Generally speaking, cost is about \$20 per acre per method.

Equipment and techniques are slowly but steadily being improved, more or less in proportion to the overall effort expanded. Petroleum seismic instruments are becoming more and more highly specialized and complex, with large number-multi-traces, magnetic recording, and multi-variable, playback-transcribing consoles. Decreased demand and in-

creased competition have kept contract seismic prices down despite major increases in equipment and operational costs. (Average crews cost \$30,000 per month, about three times that for the most expensive ground crews in mining.)

Excluding labor, many geophysical methods and equipment costs, except seismic, have decreased considerably compared to the cost of other subsurface exploration methods. This brings about a cost balance that favors utilization of geophysics in line with its capabilities.

ARIZONA SITUATION

Considering all factors, including the state's geologic and economic make-up, Arizona has been more active in geophysical exploration than most other similarly constituted states, but still less so than several of the Canadian provinces. Not only has interest in oil been stimulated recently by the first commercial discovery in the state, but Arizona is also one of the major mineral-producing states, with excellent weather conditions and easily accessible terrain than can be explored efficiently throughout the year. Aside from these specific advantages, the following resumé of geophysical work in Arizona is fairly representative of what is going on elsewhere in applied geophysical exploration.

Petroleum: During the last few years at least a dozen petroleum geophysical crews have been con-

centrated in the Four Corners vicinity. As usual these were predominantly seismic crews, but there has also been considerable aerial and ground magnetic reconnaissance as well as some gravity work. The unique deep canyon and rim topography of this area has presented quite a challenge to the field geophysicist. So far the successful solution has been to employ a combination of airplanes, extensive dozing, portable operations, and occasional helicopters. Although most of this has been done in the northeast corner of the state, much, surprisingly, has also been carried out in other areas. As far south as Nogales and as far west as Yuma several large companies, as well as wildcatters, have engaged in various small campaigns in addition to making so-called academic studies. Resulting production has so far been confined to the Navajo Reservation.

Uranium: Compared with several years ago, radiometric prospecting in Arizona has practically ceased. So far, discovery ratios have been poor and production small, usually almost nil. Drillholes, however, continue to be radiometrically logged more or less methodically, and most companies and constant prospectors still use their surface radiation instruments on occasion.

Mining: Quite a few of Arizona's metal provinces have now been magnetically flown. No ore discoveries have been reported from the results, but undoubtedly the regional interpretations derived from these surveys will contribute much to overall geologic knowledge. It is very doubtful that the little aerial electromagnetic (E.M.) work done in conjunction with the magnetic flying was successful, owing to excessive depth of cover. Penetration requirements limit application of aerial E.M. equipment in its present state of development.

Hand magnetometer, surface E.M., natural potential, and other electrical methods and geochemical procedures still prevail in most metal mining work. A considerable number of mobile magnetometer surveys have been satisfactorily run and on at least one occasion have helped reveal marginal grade ore.

Since Newmont moved its geophysical headquarters from Jerome to Connecticut early in 1958, Phelps Dodge and Kennecott have had the largest continuous geophysical programs in Arizona, both in research and application. In recent months Phelps Dodge seems to have expanded its efforts slightly, whereas Kennecott may have cut back a little, probably to stay in line with 1958 budget reductions brought about by lower copper prices.

Several other large companies have conducted substantial but intermittent surveys, and there have been quite a few lesser jobs done by smaller companies and individuals. One of the larger sulfur companies has been actively applying geophysics to detailed sulfide studies in the state. One substantial Arizona mining geophysical exploration project has been suspended because stringent West Coast oil economics have confronted the program's backer. Asarco has completed fairly extensive and detailed experimental and applied geophysical operations in the vicinity of its Pima District project. It is believed that the company obtained favorable results with several methods. Further work will probably depend on developments in Asarco's East Pima program and on the general metal market conditions, both of which now appear more favorable.

Present Facilities: The University of Arizona is accumulating a sound nucleus of personnel and equipment and is also developing a curriculum in geophysics and geochemistry as applied to mining, water, engineering, and petroleum problems. Several projects are under way or in formulation. A research geophysical laboratory is being equipped and the University staff is being augmented as rapidly as is consistent with need and demand. Other well established university departments or facilities will add immeasurably to the geophysical program—physics, chemistry, geochemistry, mining, electrical engineering, atmospheric physics, and various related computing center activities.

At last three Arizona consulting and contracting firms offer different degrees of geophysical services and related services and equipment to industry. Two are in Tucson and one in Phoenix. There are also several experienced individual consultants. Instrument development and maintenance is aided by several large electronic and mechanical instrument manufacturing firms and numerous small outfits in Phoenix, Tucson, and elsewhere in Arizona.

CONCLUSIONS

Most mining people now more or less accept the usefulness of modern exploration tools and techniques, at least occasionally. A few have reached a small area of general agreement as to the proper time, place, and conditions for specific applications, akin to the routine statistical methods long familiar in petroleum exploration. Unfortunately, however, there are still some widely divergent views, particularly among mining management, as to when, where, and how to use specific methods and equipment.

The long-continued and most customary applications of physical science engineering, including geology, are too often considered merely follow-ups in attempts to solve existing problems or to extend known features. From a non-research, applied standpoint, this often leads to uses that are beyond current capabilities. There remains an alternate approach, successfully demonstrated but much less frequently used. This is to look initially for geophysical-type geology or for problems ideally tailored to the methods intended.

More experience gained through greater geophysical utilization has aided the improvement of all methods, equipment, and applicability. Some exchange of information between practicing companies and individuals has also helped, but there is much to be done in this area which will be of maximum benefit to the industry. Actually, it has often been proved that a valuable-true geophysical secret rarely exists for long. Frequently the secret-holder misses out on other new developments while guarding his own, and usually his idea requires free competitive scrutiny before a reasonably true appraisal can be made. The importance of this problem in efficient development of our natural resources cannot be over-emphasized.

Recent improvements in the business outlook will again provide expansion in exploration budgets and related geophysical expenditures. Substantial optimistic factors exist for increased success ratios in domestic mining geophysics. And, finally, there are many foreign opportunities which present a major challenge to our engineering ingenuity in both mining and petroleum exploration and development.

DESIGNING FOR TAILING DISPOSAL IN THE SOUTHWEST

Pointers on planning effective, adequate disposal areas. San Manuel found that use of cyclones saved the day when tonnage outran tailing dump space, and made for firmer dam faces as well.

by E. V. GIVEN

Designing a tailing dam is a major step toward fully integrated mill operation. In the case of large concentrators considerable planning is necessary, and the site of the tailing disposal area may very well dictate the location of the concentrator itself.

Before a suitable location can be selected several pertinent factors should be investigated: estimated life expectancy of the mine and, if possible, approximate total tonnage; knowledge of daily mill capacity; and the possibility of future mill expansion. In addition, the area should be able to store tailing for many years and, from a cost and maintenance standpoint, gravity flow will probably be desired.

ONE POND OR TWO

After an appropriate location has been selected a choice must be made on comparison of the merits of one large pond with those of two or more smaller ponds. While initial costs would probably be lower in equipping one large dam, the single dam may lack flexibility, forbidding isolation of certain areas for drying and compaction, denying use of more than one feed line for continuity of operation, and it also may be unusable in an emergency. The terrain of some locations may force the use of several dams to obtain a big enough area for the tonnage involved.

Prior to actual construction an overall picture should be drawn showing proposed dams necessary for several years of operation. An outline will be required of pipelines, flumes, drop boxes, junction boxes, and lighting for the dams. The dewatering

system should go on paper showing decant lines (or proposed method of removing reclaimed water), de-water towers, settling and storage basins, pump house, and return water piping to plant storage tanks.

Optimum size of dams will be controlled by type of terrain, daily tonnage, and choice of the operator. If more than one dam is constructed overall area should be large enough to allow each individual dam to be placed on a routine operation and shut-down schedule. If only one dam is to be used it must be big enough to allow sections to be isolated for a time, for drying, compacting, and building berms.

CYCLONES CAN HELP

Minimum area required will be controlled to some extent by the type of waste material and the slime it will contain and by drying time for road and berm building equipment. At times cyclones can be used to great advantage, and with some ores they are practically an economic necessity. With ores that require a fine grind or contain considerable colloidal slimes the area necessary will be decreased when cyclones are employed. Experience with cyclones at San Manuel is detailed below.

Probably no two concentrators employ the same acreage per ton per day. In most cases dams are laid out so that available acreage increases as the berms grow higher. A common mistake is to start with too small an area. Trouble is often experienced with an inadequate disposal area, wet and soggy faces, and insufficient time for drying and building berms. It is difficult to state the area necessary for a given tonnage when conditions are unknown, but, as a rule, a minimum of 11 or 12 acres per 1000 tons will be re-

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quired. Most large concentrators have 16 or 18 acres per 1000 tons, or more. San Manuel, at present, has only 9 acres per 1000 tons of material but cyclones are used on all dams.

BUILDING BERMS

The original berms are usually built with material from surrounding ground at the dam site or from mine waste or overburden. Use of keyways in the base of the dams is a matter of opinion—some operators claim that a keyway will trap seepage water and eventually saturate portions of the dam base. Of four dams in use at San Manuel three have keyways. Perhaps it is only coincidence, but the one without the key has given more trouble than all the others combined.

Minimum height of the earth berm depends on the slope of the storage area facing the dam. This available storage area, of necessity, will cover enough acreage to handle operations for some months. Original berms or dikes are usually constructed with a face slope of $1\frac{1}{2}:1$, and the material should be compacted as the berms are built. Traffic of heavy equipment used for transporting fill will normally be adequate for compaction. The top of the berms should be wide enough for a roadway to accommodate heavy equipment and also allow space for the distribution header, pipes, valves, and so on.

SELECTING PIPE

In the selection of pipe for transporting tailing to the dams there are several types from which to choose. To avoid excessive wear, all should be installed with the least slope necessary to maintain flow of the pulp. Wood stave pipe, concrete pipe, and pipe fabricated from cement and asbestos are the most commonly used, and all give good service under certain conditions. Some types of wood stave pipe have a tendency to deteriorate, so soil conditions should be checked before a final decision is made to install this type. As a further safety measure wood lines should be treated with a wood preservative to prevent rot and ought to be installed above ground in open air where practicable. Water or pulp should be run through the pipe at all times, as deterioration will be speeded if the pipe is subjected to dry and wet periods.

With concrete pipe and cement-asbestos pipe there will be no deterioration except that caused by abrasion. Although concrete and cement-asbestos pipe may be the more expensive in initial installation they will probably prove most economical over a long period.

RECLAIMING WATER

Water reclamation is intimately associated with tailing disposal, and at most large concentrators in the southwest it is compulsory to recover as much water as possible. Water will normally collect on the low back edge of the settling area and it must be removed quickly to avoid excessive loss from evaporation, absorption, and seepage. One of the most satisfactory methods of recovering this water is through concrete ducts laid on natural ground underneath the original berm and extending upslope through the settling area. Ducts are installed at approximately 90° to the dam faces. This dewatering pipe or duct has 6 or 8-in. holes at spaced intervals along the side or on top for decantation. As slimes encroach on the open holes they are stoppered with wood or specially-made cement plugs. Round concrete water towers are built where necessary and connected to

the decant lines on ducts. Towers are 5 or 6 ft ID and have decant holes around the tower, arranged in a spiral pattern. Water from the towers and ducts is routed to reservoirs and settling basins, then to pump stations where it is ultimately returned to the mill storage tanks.

TAILING DISTRIBUTION

After the disposal area has been selected and the height of the earth berms decided, it will be necessary to lay out pipe lines or flumes for transporting the tailing to different distribution points. At new concentrators in the southwest the trend appears to be in favor of pipe instead of open flumes or launders. This system is relatively simple and easy to control compared to the old orthodox method of supporting the distribution header on high overhead structures. It is more economical in all respects, and there is less down time between cycles when it becomes necessary to raise the distribution manifold.

PRACTICE AT SAN MANUEL

San Manuel uses pipe for conveyance and distribution of tailing and a description of the installation at this southern Arizona property should be of interest.

Distance from the tailing thickeners to the face of the lower dams is about $1\frac{3}{4}$ miles, with a ground slope averaging 5 pct. Pipe lines are placed on an inclination of half of 1 pct to minimize wear from abrasion, with drop boxes installed at intervals to compensate for the excessive slope. Spacing varies between drop boxes, with the longest run being 1200 ft. Heights of the different boxes are from 12 to 24 ft. Tailing leaving the thickener area averages between 44 and 48 pct solids and is carried in a 30-in.-ID wood stave line. Junction boxes are located at strategic points, where the pulp is split and sent to the dams in two 18-in. lines. All 18-in. lines on the dam faces and wings are cement-asbestos pipe.

The original earthen berms for the different dams are from 2600 to 3200 ft long. Top width is a minimum of 30 ft, to accommodate the 18-in. distribution header or manifold and an equipment service road. The header itself is installed flat and level on wooden saddles for the full length of the dam face and a portion of the wings. Flexibility is good since it is feasible to feed this distribution manifold from either end or both ends simultaneously. As two of the 18-in. pipes are needed to handle the total tonnage, this method of feeding the manifold from both ends will place all the tailing in one dam, if this is desirable.

To keep pressure up, drop boxes nearest the header are removed as the berms grow in height. A minimum of 5 or 6 ft of head is needed for each 1000 ft of header, plus the height of the berm above the header, plus an added 8 or 10 ft of head to sustain a few pounds pressure into the cyclones.

Headers are equipped with 4-in., round port, lubricated plug valves at 26 or 52-ft centers, depending on the available area behind the berm. Thin wall steel pipe connects to the valves and delivers the tailing over the berm into the storage pond area (see illustrations). Practically all the tailing at San Manuel is discharged through cyclones which are mounted on light-weight stands, 4 ft high. Stands and cyclones are placed on the inside edge of the berm, with the cyclones installed about 15° from the horizontal, sloping towards the apex or underflow discharge.

When the dam has been filled the tailing will be

routed to one of the other prepared pond areas. The filled dam will be allowed to dry, cyclones removed, and a new dragline berm will be built from the sands deposited by the cones. Cyclones will again be installed and connected to the 4-in. feed lines, and the process will be repeated. Cycle time on the different dams will vary—the smaller ones may be pushed hard to gain acreage as rapidly as possible. Dragline berms will be built as soon as the sands have dried sufficiently to support the weight of the dragline equipment. The larger dams will have a rest period from one to two and one-half months, and this cycle time is growing constantly as the storage area becomes larger.

Following the described method the dams reach a maximum height of 30 to 35 ft above the distribution header. At this level a new service road is built, the distribution header is raised to the new road and relocated, and a new dragline berm is made ready.

Use of Cyclones: Before leaving the subject of berm building special emphasis should be given to the use of cyclones at San Manuel. Although overall planning and design were good, it became apparent that the area available for tailing disposal had not been sufficiently developed to handle the tonnage involved. A relatively fine grind did not help the situation, and it was readily seen that it would take many months of drying time before the tailing would support equipment. Two 12-in. cyclones were given a test run. The improvement was so evident that ten more were placed in service. Following a test period with this battery of 12 cones vs open pipes it was decided to fully equip all dams for cyclone operation.

It can be truthfully said that without the cyclones it would have been necessary to curtail mine tonnage or institute a costly crash program of building and equipping new dams—perhaps both. Also, the dam faces built up from this coarser tailing fraction are considered superior to dikes made from slimes.

Water Reclamation: Reclaimed water is an extremely valuable commodity at nearly all milling operations in the southwest and San Manuel is no exception. San Manuel's dams are equipped with 16 or 18-in. dewater lines buried in the ground beneath the tailing close to the center of the storage areas, and are placed at approximately right angles to the dam faces. The water pool is collected over this line and is controlled by discharging the tailing at different points along the dam face and wings. Water is decanted through concrete towers and 10-in. standpipes connected to the decant line. The decant lines connect to a large water header or collection line below the dams which gathers water from all the ponds and conveys it to settling and storage reservoirs and the pump station.

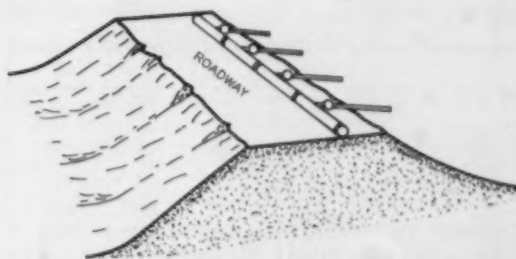
An accompanying illustration shows the general outline of all dams (in operation and proposed) and the piping necessary for a well-balanced operation. Other sketches show the method of feeding the dams, distribution manifolds, berms, and cyclone installations.

All too often insufficient thought and time is devoted to preliminary planning in tailing disposal. There can be no greater headache than trying to impound tailing in an area inadequate to handle the volume and tonnage. Disposal and storage of large volumes, maintenance of dams and equipment, and the efficiency of the operation from an economic standpoint will depend, to a great degree, upon the consideration given to original planning and design.

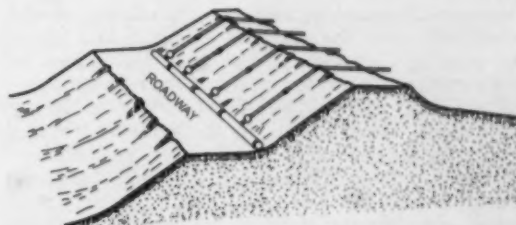
TAILING DISPOSAL AT SAN MANUEL



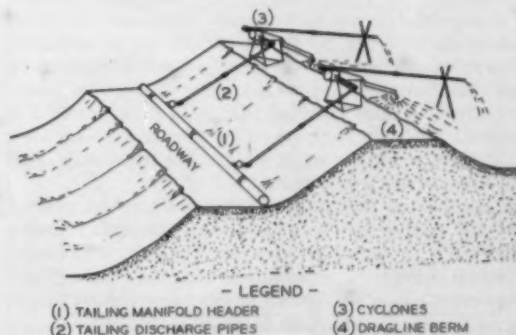
Proposed and operating tailing dams.



Original earth berm showing installation of header and discharge pipes into storage area.



Dragline berm and method of raising tailing from header over top of berm into tailing dam.



— LEGEND —
(1) TAILING MANIFOLD HEADER (3) CYCLONES
(2) TAILING DISCHARGE PIPES (4) DRAGLINE BERM

Cyclone operation.

DIFFERENTIAL THERMAL ANALYSIS FOR ORE TREATMENT STUDY

Many of the knottiest problems in mineral treatment involve finely divided materials or slimes. Clays and similar materials often encountered are particularly suited to study by differential thermal analysis.



Sample holder

by WILLIAM I. WATSON

Problems encountered in beneficiating mineral raw materials become increasingly difficult as there is a shift to lower grade and more complex raw materials, and because of the economic need to strive for ever higher recoveries, higher grade products, and lower processing costs.

Methods of attacking the many problems should include not only the familiar chemical and physical tests and equipment, but such techniques as X-ray analysis, infra-red analysis, differential thermal analysis, and the use of electron and X-ray microscopes. Many people in the mineral-treating field are unfamiliar with these newer methods and techniques. The differential thermal analysis method, in particular, does not seem to be very well known, even though it offers interesting possibilities in the study of many ore treatment problems.

Method: Differential thermal analysis (DTA) has been used with considerable success for many years, particularly by mineralogists and soil scientists. It is applicable to any material that, on heating, undergoes thermal reactions which begin abruptly and are completed in a relatively short temperature interval. Suitable apparatus determines the temperature at which thermal reactions take place in a material when it is heated continuously at an elevated temperature, as well as the intensity and character of such reactions.

A sample of thermally active material is placed side by side with a sample of thermally inert material in a suitable specimen holder. The temperature difference (measured with thermocouples) between the two specimens is recorded continuously

as they are heated. As long as no reaction occurs, there is no temperature difference; but as soon as a reaction starts, the thermally active specimen becomes hotter or colder than the inert material, and a peak develops on the curve of temperature difference vs temperature. The peak temperature is characteristic of the material, and the peak area is proportional to the amount of reacting material present.

Equipment: Many different types of equipment are used for analysis, but all are based on the general principles discussed above. The accompanying photos show different types of thermal apparatus and illustrate the range of complexity possible.

Equipment needed will depend on problems to be studied and the required accuracy and reproducibility of the data. Space does not permit complete discussion of equipment or the many necessary details of apparatus and technique. Among the more important factors are shape and type of sample holder, size of sample, particle size of sample, heating rate, heat source, position and type of thermocouples, and method of packing the sample.

Typical Results: Examination of a few typical curves indicates the type of data obtained from differential thermal analysis. (See accompanying illustrations.)

The curve obtained from the clay mineral kaolinite illustrates the usual presentation of differential thermal data. This mineral shows both endothermic and exothermic reactions. Endothermic reactions are shown below the horizontal line and exothermic reactions are shown above the horizontal line. The temperature at which these peaks occur is characteristic of this mineral, and the peak height and peak area are proportional to the amount of

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kaolinite present. The 590°C endothermic peak is due to the loss of lattice water, and the 950°C exothermic peak is due either to the formation of $\gamma\text{Al}_2\text{O}_3$, mullite ($3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$), or possibly a combination of both. This peak is not completely understood at present.

Montmorillonite (bentonite variety) shows the low temperature endothermic (loss of interlayer water) reaction, the 700°C endothermic loss of lattice water reaction, and the higher temperature effects common to this type of material.

Quartz shows an endothermic reaction at about 575°C, representing the alpha to beta quartz transformation.

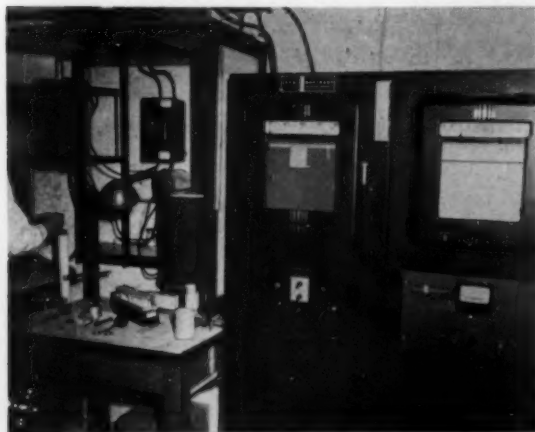
The calcite and aragonite curve shows how these two dimorphous materials can be distinguished by DTA (shift in peak temperature and small endothermic reaction on aragonite.)

The Hawaiian lateritic soil curve shows the complex nature of such materials. This sample has the low-temperature endothermic peak indicating allophane. Some gibbsite shows but it is masked out by the exothermic reaction of burning organic material and the kaolinite's endothermic and exothermic reactions.

Applications: DTA has been used primarily in the study of clay minerals, and much work has been done in this area. The clay minerals are essentially hydrous aluminum silicates with magnesium or iron taking the place, wholly or in part, of the aluminum in some minerals, and with alkalis or alkaline earths present as essential constituents in others. They include such minerals as kaolinite, halloysite, montmorillonite, illite, chlorite, vermiculite, sepiolite, and micas.

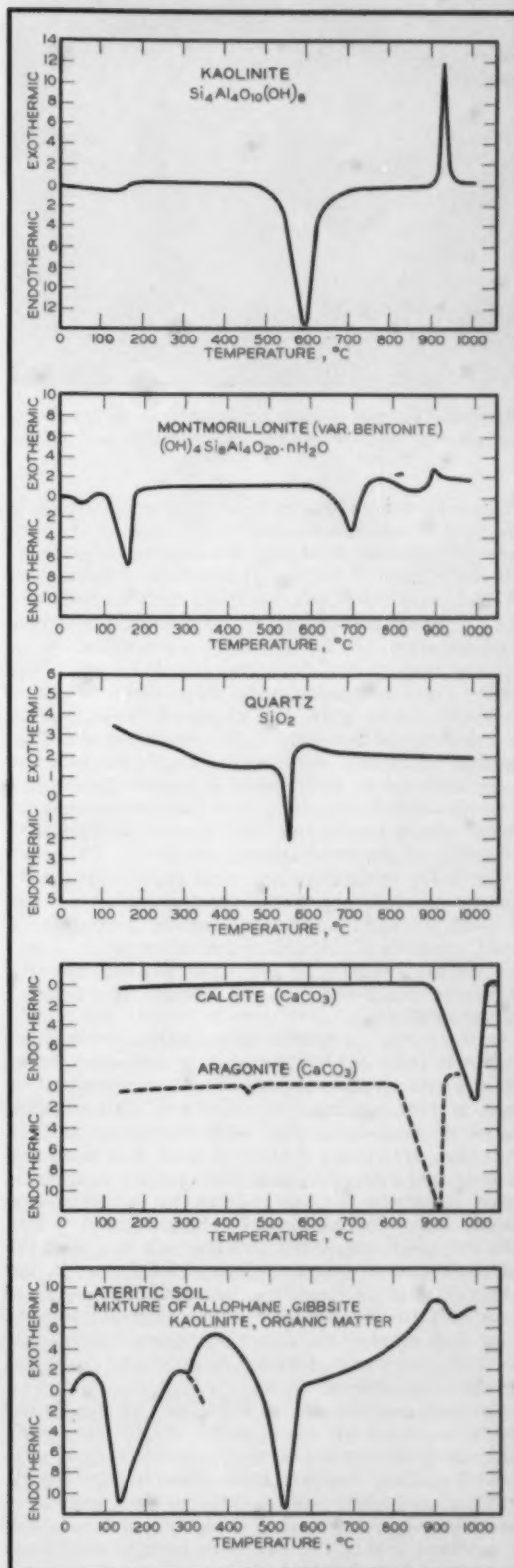
Most of the clay minerals, when pure, give such definite differential thermal patterns that identification is usually possible.

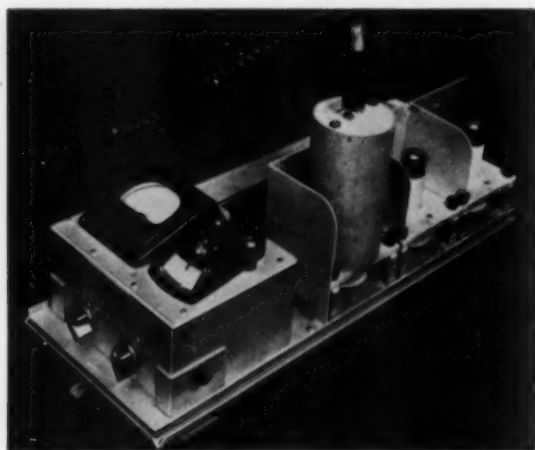
In general, it is possible to determine quantitatively the mineral constitutions of mixtures whose prime constituents can be obtained and analyzed independently to establish standard peak areas. Complex natural mixtures of inter-stratified minerals (montmorillonites, micas, chlorites) are somewhat more difficult to study, and only semiquantitative results are possible with DTA.



Note furnaces above head and to right of researcher who is loading sample holder. Instrument at upper center is a recorder controller which controls furnace temperatures; the box below it holds the duration adjusting type control unit. The graphic instrument at the far right records the differential thermal analysis; below it is a preamplifier.

Typical DTA Curves





Differential thermal analysis equipment can be effectively used even in sizes as small as the portable unit, above.

In connection with ore treatment applications in this field, Pask and Davies¹⁰ have studied the differential thermal analysis of clays in relation to acid extraction of contained alumina. Natural clay deposits vary considerably in alumina content and also in their percentage of extractable alumina. Determination of the mineral composition is of primary importance since the alumina can be extracted from certain minerals only, namely those of the kaolin type. Pask and Davies have correlated the solubility of the various clay and other alumina-bearing materials with mineralogic composition. They determined that with a knowledge of the mineral composition of a clay (as determined by DTA), the percentage of alumina extractable with sulfuric acid can be predicted.

The DTA technique has also been successfully used in exploration for and metallurgical treatment of bauxites and aluminous lateritic materials. A small, portable DTA unit permits rapid field determination, making it possible to estimate the grade and hence the value of the soil as a bauxite source material.

As the curve for quartz shows, this mineral gives a distinct DTA curve. The peak is the result of an endothermic reaction representing the conversion of alpha to beta quartz at about 575°C. This reaction makes it possible to use DTA for quantitatively estimating free silica content of ores, mill products, ceramic raw materials, and silica products. Quantitative determination of quartz in flotation and gravity separation products has been applied to iron ores, feldspars, and clays. Another use has been the determination of quartz in industrial dusts—in the study of silicosis hazards. Advantages of DTA in these uses are its ability to distinguish quartz from other free forms of silica, its applicability to fine material, and the fact that it is a simple, rapid, inexpensive procedure.

Another application of DTA in ore treatment problems has been in a study of the lime-soda sinter process for recovery of alumina from siliceous bauxites, kaolins, and other highly aluminous materials. The process involves the sintering of the siliceous bauxite with limestone and soda ash in a rotary kiln. DTA was used here to determine the temperatures at which phase changes occurred

during sintering. It was also helpful in determining just what chemical reactions were taking place.

DTA has also been used in the study of sulfide minerals and borate minerals and mixtures. Although analysis of these materials requires special equipment and procedures, the method shows promise in study of ore treatment products.

Many other mineral materials such as carbonates, halides, sulfates, nitrates, and phosphates have been studied by DTA. In one case DTA showed, in four hours time, that of two supposedly identical samples of alunite, one of them had been calcined.

Carbonates are particularly amenable to study by differential thermal analysis because they decompose with the absorption of large amounts of heat, and they do not generally sinter. For example, calcite can be distinguished from aragonite and dolomite can be distinguished from mixtures of calcite and magnesite.

Other applications of differential thermal analysis include: estimating organic matter and water content; predicting the firing behavior of structural materials; estimating the kaolin content of sillimanite for glass block manufacture; analyzing gangue minerals in chrome ore and studying variations in the ore itself; analyzing kaolin content of graphite; estimating zeolites; studying the rank and coking properties of coal.

Many practical problems in the materials field have been solved by DTA. It has been shown, for example, that excessive weathering of clay brick was due to underfiring, that decayed limestone building block was contaminated by magnesium sulfate, and that the poor quality of certain slates was due to too much calcite and pyrite.

Summary: The differential thermal technique can give information not readily obtainable by any other method; it is applicable to crystalline and amorphous materials, whereas X-ray is applicable to crystalline materials only; it can in some cases detect and estimate materials present in amounts of about 10 pct, with an accuracy of ± 1 pct; it will give data on the temperatures of phase changes; and, it is a rapid, low-cost procedure.

As with any technique, DTA has limitations and disadvantages. Perhaps most important of these are its limited applicability to materials having strong, fast thermal reactions, and the often difficult to interpret results obtained on some complex mixtures. However, this method of study should certainly receive greater consideration by people in the mining industry, especially those working on difficult metallurgical problems involving clays and other materials amenable to the technique.

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THE GEM STOCKS AND ADJACENT OREBODIES, COEUR D'ALENE DISTRICT, IDAHO

by GARTH M. CROSBY

Seven mines with important production records in the Coeur d'Alene lie adjacent to the Gem stocks—the Frisco (Gem), Hercules, Interstate, Rex (Sixteen to One), Success (Granite), Sunset, and Tamarack. Old records are incomplete, but available data given in Table I show these mines have produced 10,550,721 tons of ore containing more than 50 million oz of silver, more than 1.5 billion lb of lead, and about 1 billion lb of zinc (approximately 1.25 million tons of lead and zinc combined). Average ore grade is 4.8 oz of silver per ton, 7.2 pct Pb, and 4.6 pct Zn.

This impressive production represents about 12 pct of the District's yield. At present metal prices, with modern beneficiation, the gross value would be more than \$400 million.

THE GEM STOCKS

The Gem stocks, considered to be outliers of the Idaho batholith of Late Cretaceous age, are located in the northern half of the Mullan quadrangle, and extend from the town of Gem, Idaho, along a strike of N30°E for a distance of approximately five miles. They occur as two major masses of monzonitic rocks commonly referred to as the North stock, which covers an area of 1.1 sq miles, and the South stock, which covers 2.6 sq miles. The areal pattern is roughly club-shaped, the North stock representing the handle and the South stock the head of the club. Two and a half miles west and five miles northeast are two groups of smaller stocks, isolated from the main masses but of the same general rock type. This discussion is limited for the most part to the North and South stocks.

GARTH M. CROSBY is Chief Geologist, Day Mines Inc., Wallace, Idaho. TP 48101. Manuscript, Dec. 19, 1958. Pacific Northwest Regional Conference, Spokane, Wash., April 1958. AIME Trans., Vol. 214, 1959.

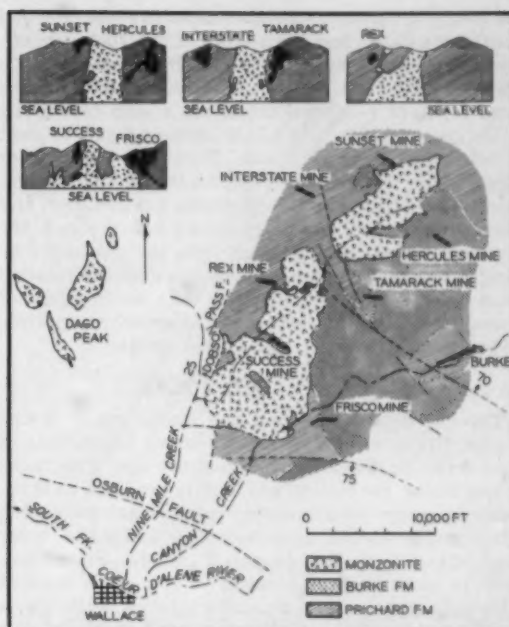


Fig. 1—Gem stocks area, Wallace, Idaho. Geologic map and generalized longitudinal sections of the oreshoots.

At the north end, where the intrusion is about 3200 ft wide, the walls are about parallel and dip very steeply west. At the south end, where the mass is about 7000 ft wide at surface, the walls dip away from each other at moderately steep angles. An aeromagnetic survey¹ detects and outlines with surprising accuracy the two main stocks, as illustrated on the magnetic contour map (Fig. 2). Of particular interest is the location and shape of the magnetic anomaly representing the South stock. The anomaly is centered over the south end of the outcrop, and a westerly extension joins it with a smaller anomaly over the Dago Peak stocks. The latter anomaly, likewise, is located over the south end of the isolated stocks. This pattern suggests the intrusion has greater extent at depth to the south and west. Though correlation between the Dago Peak stocks and the larger masses is suggested, the controversial aspects of the Dobson Pass fault, which separates the two areas, casts doubt on a correlation.

Topographically the monzonite stocks are ignored by the drainage pattern indicating these rocks, and the invaded rocks of the Lower Belt Series react similarly to erosion. The drainage patterns of Nine Mile and Canyon creeks cut indiscriminately across the monzonite-Belt contact, resulting in both valleys and ridges in the southern end of the intrusion. Nine Mile Creek traverses diagonally the entire five-mile length of the stocks.

The monzonite rocks of the intrusion are referred to locally as *granite*, but granite is rare and the rocks comprise a wide variety of types. Their characteristics, described in detail by F. L. Ransome and F. C. Calkins,² are summarized by P. J. Shenon.³ The principal rock type is coarse-grained, light gray, porphyritic monzonite containing black crystals of hornblende. Pyroxene, epidote, and titanite

are seen commonly in the hand specimen, and quartz is usually less than 5 pct of the rock. Phenocrysts of microcline and microperthite occur in a ground mass of smaller equidimensional plagioclase crystals. Carlsbad twinning is seen commonly in the phenocrysts, and albite twinning can be seen in some of the groundmass. Rocks in the smaller Dago Peak stocks differ from the main masses, chiefly in grain size. Phenocrysts are smaller and the groundmass commonly is so fine-grained the minerals cannot be identified with the unaided eye. Classification of the rocks is governed by the relative abundance of the phenocrysts; with an increase of phenocrysts the classification approaches syenite, and with a decrease it approaches diorite.

THE INVADDED ROCKS

The ore deposits around the stocks occur in the Burke, Upper Prichard, and Prichard formations of the Lower Belt Series of Algonkian age. The rocks of the Burke Formation are chiefly medium to thin-bedded, gray argillaceous quartzites, becoming progressively more argillaceous toward the older Prichard rocks. The Upper Prichard Formation, 1800 ft thick, contains massive and thick-bedded relatively pure quartzites interlayered with black argillites. Argillite is the dominant rock of the Lower Prichard Formation.

CONTACT METAMORPHISM

A thesis study by A. M. Piper¹ discloses that the intruded rocks are metamorphosed in an irregular rim extending 50 to 100 ft away from the monzonite. Within the argillaceous rocks of this zone magnetite, garnet, pyroxene, biotite, and epidote have been developed, as well as some andalusite. The relatively pure quartzites contain a few of these minerals in only small amounts but they have been recrystallized generally, which gives them a brilliant, sparkling appearance. The various rocks resulting from these changes are classified as hornfels.

Ransome and Calkins (Ref. 2, p. 72) mention the absence of schistosity and cleavage in the invaded rocks and the absence of arching in the vicinity as evidence that high pressures were not present during emplacement. Stopping of the invaded rocks by the magma is suggested as the dominant process of intrusion. Embayments and tongues of country rock and several isolated remnants of the Burke and Prichard formations in the monzonite support the theory. The most certain evidence for the argument is a stope block of the Wallace Formation located near the north end of the South stock. The nearest exposures of the Wallace Formation are at least several miles away, and this Wallace remnant must have settled through the magma several thousand feet to occupy its present position.

The mines adjacent to the Gem stocks can be divided into two geographical groups (Fig. 1). Three important mines, the Hercules, Tamarack, and Frisco, are located on the east margin of the intrusion and four others, the Sunset, Interstate, Rex, and Success, are on the west side. Within these mines 29 productive veins occur. Average strike is 75° W and dips are moderately steep to vertical. Veins dip both north and south. Stopped widths range from less than 5 ft to several tens of feet, but the average is estimated to be about 10 ft. Viewed in vertical longitudinal projection the oreshoots display the characteristic shape found in the Coeur d'Alene district, that is, a greater vertical than horizontal dimension. These mines are recognized as members of three or four extensive mineral belts along which other important mines are located. Consideration of these belts, now under study, is not within the scope of this paper. It should be pointed out, however, that the orebodies adjacent to the stocks represent their respective mineral belts at the margin of the stock.

Types of Deposit: The orebodies located around the stock are classified as hypothermal replacement veins. They are characterized by tabular shapes and shearing, with the exception of those in the Success mine. Here shapes are very irregular, and it is usually difficult to find fractures leading away from the ends of ore shoots. The Success orebodies, then, are classified as contact metamorphic. J. B. Umpleby and E. L. Jones² consider the orebodies of the Frisco, Rex, and Sunset mines closely related in origin to typical contact deposits, since these contain silicates and magnetite intimately associated with metallic sulfides. The orebodies of the Hercules, Tamarack, and Interstate mines also contain high-temperature minerals and can be included in the contact group.

Mineralogy: Gangue minerals common to the deposits are quartz, pyrite, siderite or ankerite, and magnetite. Stringham, Galbraith, and Crosby³ report pyrrhotite, biotite, garnet, chlorite, hematite, and grunerite as major constituents of the veins in the Hercules and Tamarack mines. A study of paragenesis of minerals in the Hercules mine suggests five stages of mineralization. In the first stage, known as the Silicate stage, biotite, andradite, grunerite, and chlorite were formed. In the second, the Carbonate stage, siderite was formed and in the third, the Oxide stage, magnetite was formed. The fourth stage, known as the Sulfide stage, is subdivided into the Early and Late substages. During the Early Sulfide substage pyrrhotite and pyrite with some chalcopyrite and arsenopyrite were formed. Galena, sphalerite, and some jamesonite were formed during the Late Sulfide substage. Grunerite and siderite occur in roughly reversed proportions from top to bottom in the mine, siderite being the

Table I. Production from Mines Adjacent to Gem Stocks

Mine	Tons	Ag, Oz	Pb, Pct	Zn, Pct	Silver, Oz	Lead, Lb	Zinc, Lb
Frisco	2,000,000	2.9	4.8	2.4	5,800,000	192,000,000	95,000,000
Hercules	3,482,023	8.7	11.0	1.3	30,293,500	765,045,060	90,532,398
Interstate	956,000	2.0	5.2	17.4	1,900,000	98,800,000	330,600,000
Rex	169,762	1.4	3.2	3.2	237,667	10,864,768	10,864,768
Success	783,975	1.3	3.0	7.4	1,019,168	31,359,000	116,028,300
Sunset	307,429*	2.1	4.1	6.1	645,601	25,209,178	37,506,338
Tamarack	2,857,532	3.6	6.9	5.0	10,287,115	394,339,416	265,755,200
Total	10,550,721	4.8	7.2	4.6	50,183,151	1,518,617,422	967,285,264

* These tonnages are based on relatively incomplete records but are thought to be minimum reports.

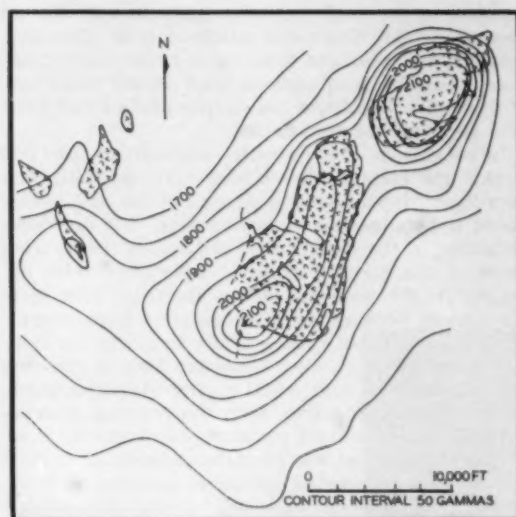


Fig. 2—A magnetic contour map of the Gem stocks area.

more abundant mineral toward the top of the orebody. In the lower part of the mine a transition zone is recognized above which the predominant iron sulfide is pyrite and below which it is pyrrhotite.

Mineral Zoning: Other observers have reported mineral zoning in the veins near the Gem stocks. At the Interstate mine there was some decrease in the amount of lead with depth, but no increase in the amount of zinc. In the Success mine Ransome and Calkins (Ref. 2, p. 184) point out an increasing amount of zinc on the 330 level, the ore having been primarily lead in the levels above. It was noted that lead oreshoots contained increasing proportions of sphalerite at their outer margins and that pyrite was the principal constituent where the vein graded out into country rock. The Hercules mine also contains a higher proportion of lead to zinc in the upper levels. In the Hercules there is an excellent example of zoning in the gangue minerals, with quartz, pyrite, and siderite on the upper part of the mine passing through the transition zone into the higher temperature minerals pyrrhotite and grunerite. West of the Sunset mine a magnetometer survey shows an increase in the size of the anomaly found over the veins as the monzonite stock is approached, indicating a corresponding increase in the amounts of pyrrhotite and magnetite occurring in the veins.

Wallrock Alteration: Wallrock alteration is not as noticeable near these orebodies as in many orebodies of the Coeur d'Alene mining district where sericitization or bleaching has been the major alteration process. In contrast, the rocks are harder and often darker than their original counterparts. The most intensely altered wall rocks occur in the Success mine, where the siliceous rocks of the Upper Prichard Formation have been changed to dark micaceous recrystallized quartzites—some colored green containing pyroxene and some pink containing garnet. Quartz schists are developed locally. An unusual rock worthy of note is a narrow though persistent biotite schist found near the ore throughout the mine. It probably corresponds to an original argillaceous layer of the Upper Prichard Formation.

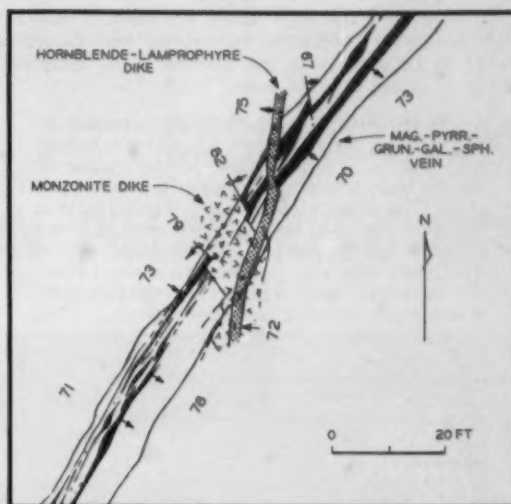


Fig. 3—Relationship of dikes to ore, 1900 level, drift west, as revealed by recent exposure in Hercules mine.

With the exception of the biotite schist, alteration has produced fine-grained, hard, tough rocks which grade into each other and into monzonite. The entire Success pendant has been altered in this manner, and the intensity of the alteration here is to be considered very great as compared to that found elsewhere in the area. Chief differences in alteration of wall rocks found in the other mines lie in the abundance and variety of contact metamorphic minerals developed. These minerals occur very irregularly in patches and confined altered zones along the veins. Normally the intensity of alteration decreases as distance from the stock increases, and at some points the wall rock is quite fresh and unaltered.

RELATIONSHIP TO INTRUSIVE ROCKS

In considering the relative ages of the monzonite and the orebodies nearby, it is helpful to observe the more common relationship of ore with dike rocks encountered in the mines. The rocks are classified as monzonite, diabase, and lamprophyre dikes. The monzonite dikes are light-colored, relatively coarse-grained rocks of about the same composition as the main stocks. The diabase dikes are gray-green to black rocks containing feldspar laths in a groundmass of pyroxene too fine-grained to be identified by the unaided eye. The lamprophyre dikes are characteristically dark, containing an abundance of well formed hornblende crystals or biotite plates in a fine-grained groundmass of plagioclase. The light-colored monzonite rocks are referred to locally as acid dikes, and all the dark rocks are loosely termed basic dikes. On surface the basic dikes are seen to be later than the main mass of the stocks and usually occur as deeply weathered zones containing decomposed rock and mud. The acid dikes do not react differently to erosion, and the relationships to the enclosing rocks are not evident. Underground both acid and basic dikes are seen in relation to ore, but to date there is no clear example of the relationship between the main mass of the monzonite and the acid dikes. This particular relationship might be difficult to determine because of the irregular apophyses of monzonite rocks at the margins of the stocks.

Underground the acid dikes are seen in contact with ore in the Success, Interstate, and Hercules mines. With respect to the Success mine Umpleby and Jones (Ref. 5, p. 5) state:

The monzonite apophyses are traversed by the ore as is clearly shown . . . where a 10 foot dike nearly at right angles to the course of the ore body is exposed in opposite sides of the stope at a point where ore was extracted to a width of about 12 feet. Another equally clear example of ore formed subsequently to the monzonite appears . . . where an offshoot from the main ore body replaces a four foot dike and extends into the quartzite beyond.

On the 100-foot level . . . the ore body, retaining its width of $3\frac{1}{2}$ to 5 feet, crosses a southwestward-dipping monzonite dike. This relation continues for 60 feet below the level, but lower down no ore was found in the monzonite, although ore has been mined in the adjacent quartzite for more than 100 feet farther down. Above the level the stope continues between granite walls for 40 feet without diminution in width. As there is notably less fracturing within the dike than beyond it, the relationships are interpreted as indicating this sequence—1. shearing, 2. intrusion of the dike, and 3. renewed shearing accompanied or followed by replacement of wall rock, whether quartzite or monzonite by ore.

In the Interstate mine, several hundred feet from the main stocks, a relatively large monzonite dike occurs. Umpleby and Jones (Ref. 5, p. 94) state that galena and sphalerite replace the monzonite here and that both ore and dike are offset by post-ore faulting.

Recent observations in the Success mine made during lessee activity suggest the ore pre-dates the monzonite. On the 1200 level ore in a stope 30 ft wide and 150 ft long is abruptly terminated at its northwest end by monzonite, which the ore abuts directly. In the southeast end of the same stope there are lenses or stringers of monzonitic material within the vein, suggesting contemporaneous ages for the monzonite and ore.

In the Hercules mine at least two acid dikes cross the vein in typical push-apart fashion. Vein material abuts the wall of the dike and shows a slight crowding against it. In a few places a very small amount of galena and sphalerite extend into the monzonite a matter of inches. The vein structure, however, does not persist into the monzonite, and the short sulfide prongs are interpreted as post-sulfide adjustments. It has been noted that these occurrences are located where small offsets in the monzonite are opposite galena or sphalerite in the vein.

The basic dikes are known to be post-ore in several mines adjacent to the Gem stocks but otherwise are undated. Some consider relationship with the Tertiary extrusives to the west not unlikely. A remarkable exposure made recently in the Hercules mine showing the relationship of basic dike, acid dike, and ore is illustrated by the map of the 1900 level (Fig. 3). The relationship of ore to the basic dike, a hornblende-lamprophyre, is similar to the previously described relationship of ore to the younger acid dike, except that no prongs of sulfides or any other vein material extend into it. The lamprophyre is younger than the acid dike and shows a very weak selvage at the contact. Where the lamprophyre crosses the vein there is a characteristic

increase in the angle between the vein and dike as viewed in plan. The same relationship is often seen between the vein and transverse faults, and it appears that the lamprophyre dike occurs along one of these structures and has simply pushed apart the vein and the monzonite alike.

In conclusion, the orebodies adjacent to the Gem stocks are classified as contact metamorphic and hypothermal. The Success deposit is the best example of the contact metamorphic type. The orebodies occurring in the other mines are distinguished from those of the Success by their association with fissuring. At the west end of the Hercules 1000 level the deposit becomes very irregular in plan, resembling the contorted shapes of ore found in the Success mine. There is, also, a marked lack of shearing and fissuring in this part of the Hercules mine. These features, together with the mineral associations typical of contact metamorphic deposits, identify this portion of the Hercules deposit as contact metamorphic. Shearing increases progressively toward the east end and top where the deposit assumes the shape of a typical lode and can be classified as a hypothermal replacement vein. The Hercules, therefore, is an example of a contact metamorphic deposit grading into a hypothermal vein deposit.

Because ore in the Success mine is seen to be later than the main mass of the monzonite in some places and earlier in other places, it is considered to be very closely related in time to the monzonite. Closer dating of the ore depends on the relative ages of the monzonite dikes and the main stocks. Though this relationship has not been observed to date, their ages are assumed to be nearly the same. The fact that the same minerals are found in the altered rocks around the stocks and in the altered rocks along and in the veins suggests that the veins are very closely related to the monzonite intrusion.

The author expresses gratitude to the management of Day Mines Inc. for permission to publish this article and especially thanks H. L. Day and R. Farmin for their encouragement and valuable assistance. The cooperation of the mining companies throughout the district has been of inestimable value, and the courtesies extended by their staff members are very much appreciated. Discussions with J. C. Kieffer, P. I. Conley, S. N. Kesten, H. E. Harper, M. W. Hutchinson, J. B. Colson, R. McConnel, and M. C. Brown have enlightened many of the problems encountered.

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Discussion of this article sent (2 copies) to AIME before Aug. 31, 1959, will be published in *MINING ENGINEERING*.

CASE HISTORY IN PILLAR RECOVERY



Fig. 2—Drillmobile modified for roof bolting.

by JOHN J. REED

The mines of southeast Missouri's Lead Belt have been in operation since 1864, almost 100 years. During this period about 10 pct of the total ore available has been left in place as pillars, and this now represents the best ore reserve left to the older mines.

St. Joseph Lead Co. has been investigating various plans of pillar recovery for several years. The example to be described is only one possible approach under a specific set of conditions. Conditions vary greatly in the different areas within the Lead Belt, and the same approach would be entirely inadequate in certain other areas, but there are important sections where this system is clearly applicable.

Horizon mining is practiced in the Lead Belt, and stopes may vary from 10 ft to well over 100 ft high. Fig. 1 is a plan view of 6100 stope, the area to be discussed. For these mines this is a small stope, only 10 to 12 ft high.

J. J. REED, Member AIME, is Head Mine Research Engineer, St. Joseph Lead Co., Bonne Terre, Mo. TP 4811A. Manuscript, Dec. 10, 1958. Mid-America Minerals Conference, St. Louis, October 1958. AIME Trans., Vol. 214, 1959.

Before any plans were drawn up for pillar recovery, three independent estimates of the pillar grades were made by the mine superintendent, the mine captain, and the mine geologist. After these results were averaged, pillars indicated to be of economic grade were marked for removal as shown. At this stage several alternatives were considered: 1) retreat with caving, 2) concrete replacement pillars, and 3) systematic bolting and retreat.

A retreating system with caving was not chosen because the roof was known to be too bad even to permit loading a blasted pillar before caving would begin. Concrete replacement pillars would have been too costly and would have required a large crew, bulky materials, and unwieldy equipment. Systematic bolting was chosen as being most acceptable for the following reasons:

- 1) Limited area and spans were involved.
- 2) Only minor modifications to the jumbo would be required for bolting.
- 3) Only a two-man bolting crew would be needed.
- 4) Only compact bolting materials would be required.
- 5) The bolting plan could be modified to allow



Fig. 1—Baker 6100 stope. Plan view of pillar removal.

for varying roof conditions and degrees of permanence in bolted roof.

EQUIPMENT

The only unusual equipment needed for this project was a roof-bolting jumbo. A rubber-tired, electric stope jumbo was modified as shown in Fig. 2. With this unit, now capable of bolting roof 25 ft high, two men can place about thirty 7-ft bolts per shift. Headed, $\frac{3}{4}$ -in. high-strength bolts were used with an expansion shell anchorage. The holes were drilled with a pneumatic drill and the bolts tightened with a pneumatic impact wrench that has an automatic cutoff at any desired torque. The wrench is mounted on an air cylinder feed which pushes the bolt up into the hole and holds the wrench while tightening. Drill and wrench are mounted on one boom of the jumbo, and an operator's basket is

mounted on the second boom. A standard torque wrench with a range of 0 to 350 lb-ft was used to spot check a few bolts periodically.

The pillars were drilled with the same jumbo used for bolting and blasted with millisecond delays. A Joy loader was used to load into a shuttle car, which transferred the rock to rail cars. A diesel bulldozer was used for clean-ups.

INSTRUMENTATION

Because this pillar removal was an experiment, and no past experience could give assurance as to what might be expected, quantitative measurements in the area affected were very important as safety indicators. The instruments used in making these measurements will be described here, because they are not widely used in the mining industry.

Convergence Extensometer: Two types of extensometers have been developed to measure total convergence in a vertical direction. The tube extensometer (Fig. 3) consists of two telescoping tubes of stainless steel with a dial gage at the top which measures convergence directly to 0.001 in. This unit will measure in stope heights from 9 to 16 ft. It has two basic limitations: 1) Because the dial gage is at the top, a ladder is required for accurate readings above 10 or 12 ft. 2) The tubes are unwieldy and inaccurate above 16 to 18 ft. For these reasons, the tape extensometer shown in Fig. 4 has been developed. On this instrument enough steel tape is stored on a reel to reach any desired height. This tape is drilled with small index holes at intervals of 0.3 ft and is rigidly pinned where desired. The entire constant weight of the instrument tensions this upper tape. The lower tape is a fixed length that will place the instrument at eye level. This tape is hooked in a floor station, passes through a guide slot and over a pulley, and is rigidly pinned to the square central sliding frame, which is further counterweighted with two lead blocks as shown. Thus the lower tape is also under a constant tension, with no springs involved. The relative motion between the main frame and the sliding frame is equal to the total convergence and is read on a dial gage with a range of 4 in. Indicated accuracy of this instrument is ± 0.003 in., since it is inherently less precise than the tube extensometer in the low ranges. However, the accuracy is adequate for the actual convergences of 0.050 to 1.000 in. being measured. These extensometers are the most useful instruments in the collection. In all, about 70 extensometer stations were placed and measured in 6100 stope. Probably 30 would be sufficient for operating purposes only.

Warning Lights: These lights (see Fig. 5) immediately warn of any convergence in a working area. They consist of two spring-loaded telescoping tubes, a micro-switch, and a flashlight. The tubes are adjustable in various stope heights, and the micro-switch can be adjusted so that a convergence of only a few thousandths of an inch is enough to turn on the light. Several of these warning lights were always placed around the stope during noisy activities such as drilling or loading.

Seismetron: This device consists of a very sensitive borehole type of geophone connected to a powerful amplifier. The theory of the equipment, and the detection of microseismic noises in connection with predicting rock failure, were developed by the USBM's Applied Physics Branch under Leonard Obert.^{1,2} Most miners can recall the audi-

Table I. Physical Properties of Rock, Baker 6100 Stope

Sample	Compressive Strength, Psi,* (1½x¾-In. Core)	Young's Modulus, Psi	Tensile Strength, Psi*
1	23,400	5,000,000	1,240
2			890
3	26,050	5,000,000	1,590
4	43,800	6,000,000	1,410

* Average of three samples each.

Table II. Pillar Recovery Results in Baker 6100 Stope

	Baker Mine, 1957 Average	Area			
		A	B	C	B + C
Ore loaded, tons		707	725	2,988	3,713
Grade, assay*	1	2.4	2.2	2.7	2.75
Cost per ton†	1	3.66	3.22	2.08	2.99
Cost per lb lead†	1	1.58	0.82	0.79	0.79
Area bolted, sq ft		12,125	12,950	43,550	56,500
Area bolted per ton		17.2	17.9	14.6	15.3
Estimated tons				2,824	
Explosive consumption, lb per ton	0.40‡			0.33	

* All these values have been reduced to ratios in order to reduce the Baker mine figures to unity.

† These are costs of ore on the ground, but not loaded.

‡ Consumption for first six months of 1958.



Fig. 3—Tube extensometer.

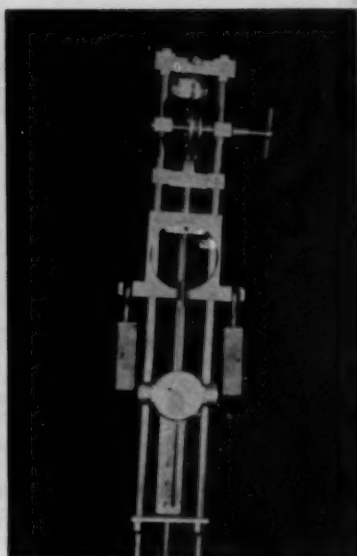


Fig. 4—Tape extensometer.

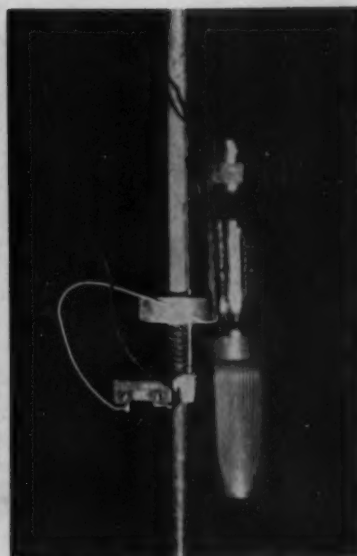


Fig. 5—Convergence warning light.

ble pops and cracks produced by the *working* of heavy ground. There is also a preliminary period during which sub-audible noises are emitted at an increasing rate as the load is applied. The seismetron[®] permits these noises to be heard and recorded at so many counts per minute.

Whittemore Strain Gage: The standard mechanical strain gage, used regularly by civil and mechanical engineers, has a gage length of either 2 or 10 in. The gage used by St. Joseph Lead has a length of 20 in. to straddle more of the inconsistencies of the rock being measured for strain. Stainless steel reference points are placed in countersunk holes as shown in Fig. 6, and the Whittemore gage measures the relative motion between the points to the nearest 0.0001 in. Its dependability and value are limited when measuring the compression in a rough rock pillar, because the reference points are anchored in a surface layer of rock which is probably loose and stress-relieved.

Roof Bolt Compression Pads: These devices, made by Goodyear Rubber, consist of two steel plates $\frac{3}{8}$ in. thick with $\frac{3}{8}$ in. of rubber vulcanized between them. They have a hole through the center to take the bolt, and in use they replace the normal bearing plate under the head of the bolt. Under load the rubber squeezes out between the plates, and its circumference is measured with a calibrated gage.

PLAN OF THE EXPERIMENT

To refer again to Fig. 1, it was decided to test-bolt in a small preliminary area before determining what to do in the rest of the stope. Area A, of limited span, was to be bolted very conservatively on 4-ft centers with 8-ft bolts, the most common length used in the mines. Before bolting began, 17 bolt-pulling tests were made in the same area to establish optimum installation specifications. Consistent results indicated that best anchorage would be obtained by the highest possible initial torque, which was set at 250 ± 25 lb-ft for all bolting in this stope. These pull tests were later substantiated

by pulling 11 more bolts in the other end of the stope.

Theoretically, this torque corresponds to a bolt tension of about 16,000 lb, but the average initial tension indicated by 15 roof bolt compression pads was about 9000 lb. This discrepancy is believed due to galling of the bolt ears in the base of the shell, torque and spring in the unusually long bolts, and perhaps a tendency to bounce and kick back in the pad itself. This problem will be investigated further.

RESULTS

Pillars 80, 81, 86, 87 of area A and breast pillar C in Fig. 1 were removed after the area was completely bolted with 7 and 8-ft bolts on 4-ft centers. The maximum convergence measured in the center of the area was 0.142 in. The microseismic count increased to 20 to 30 cpm for a few hours after blasting but within 24 hr returned to the normal background level of 1 to 5 cpm. Fifteen roof bolt compression pads installed between pillars 86, 87,



Fig. 6—Whittemore strain gage.



Fig. 7—Final form of slope with all pillars removed.

and 88 showed an average increase in load of 410 lb per bolt after one week and 720 lb per bolt after 7 weeks. When the entire 6100 slope project was completed about seven months after the first pillars in area A were removed, average indicated bolt load was 1220 lb per bolt above the installation load of about 9000 lb.

After the pillars were removed in area A, pillars 77 and 84 were blasted in area H without any preliminary bolting to give a basis of comparison. Extensometer station H-2, adjacent to pillar 77, showed a convergence of 0.212 in. 24 hr after blasting and 0.232 in. at 48 hr. The roof was too loose and dangerous to work under, so the rock from these two pillars was never loaded. During the 10 months since these pillars were blasted, 2 to 3 ft of roof have fallen over most of area H.

In view of the good results, area B was bolted on 5-ft centers. The first pillars blasted in this area were numbers 61, 71, 72, and D, which caused a convergence of about 0.081 in. in area B but had little effect on area A. However, when the two areas were joined by blasting pillars 62 and 73, maximum convergence amounted to 0.166 in. in area A and

0.118 in area B and the convergence spread outward beyond the barrier pillars 63, 74, and 82. Four hours after pillars 62 and 73 were blasted, the microseismic count was 50 to 60 per min and 24 hr later was still 35 to 45 per min. During this period boundary pillars 63, 74, 82, 64, and 65 showed signs of failure, with cracks and small slabs popping off. After four days the pillar activity had ceased, and the microseismic count was down to 10 to 15 per min. After eight days all activity had stopped, and the count was down to a normal background level of 1 to 5 per min. It is significant to note that during this period of pillar compression, extensometer stations 17, 18, and 25, in the second row of barrier pillars, showed convergences of 0.010 in., 0.019 in., and 0.015 in.

With the experience gained in areas A and B, it was decided to bolt the remainder, area C, on 5-ft centers and remove all the rest of the pillars in as rapid and continuous an operation as possible. It took a two-man crew about three months to bolt area C and drill the pillars, which were then blasted and loaded in about three weeks.

In discussing convergence as measured and reported here, it is important to note that what is observed is total convergence, which actually consists of three parts: 1) roof sag, 2) floor heaving, and 3) compression in the remaining pillars.

Roof sag is probably the largest component and certainly the one of most concern. Pillar compression can also be appreciable, as evidenced by some of the data available here. Average maximum convergence at stations 17, 18, and 25, which presumably was largely pillar compression, was 0.046 in., approximately 13 pct of average convergence measured in adjacent areas of pillar recovery (about 0.360 in.). Also, station 58 was placed only 1 ft from pillar 24 and showed a convergence of 0.127 in., or 42 pct of the total convergence of 0.301 in. measured at station 40.

Bolting in area C was planned to permit progressive pillar removal until there was failure due to excessive unsupported spans. This finally was caused by locally jointed ground and very poor bolt

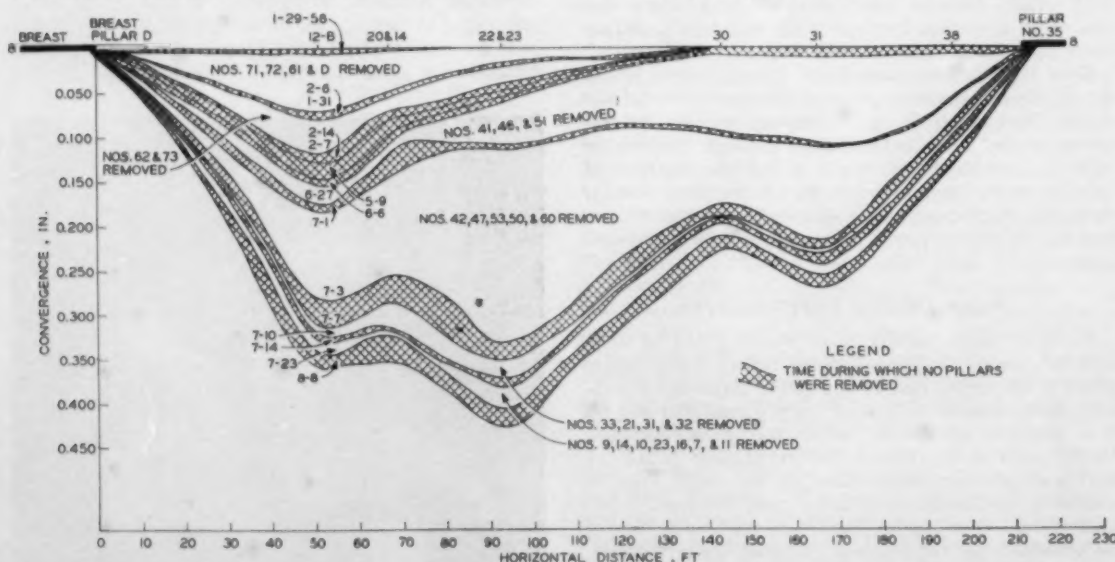


Fig. 8—Vertical section 8-8 showing convergence due to pillar removal compared with that due to time alone.



Fig. 9—Portion of stope 40L400, Leadwood South mine. Stope configuration adapted to pillar recovery by roof bolting.

anchorage in the area of pillars 9, 10, and 14, as indicated in Fig. 1. Pillars 31, 32, 33, and 21 had been removed when pillars 9 and 14 were blasted. There were no visible signs of failure at this time, and no audible sounds of the roof or pillars working, but during the two days which followed, when no further blasting was done, instruments showed that failure was imminent. Stations 50, 51, and 49 showed 0.385 in., 0.485 in., and 0.849 in. of initial convergence, which continued at about 0.005 in. per hr. Warning lights in the area turned on about every 15 min, and a microseismic count taken with the probe in pillar 10 gave about 30 cpm, with extra-strong continuous background noise. Immediately after pillar 10 was blasted, at the end of the second day, the microseismic noise became almost continuous, and there were frequent loud sounds of rock failure. Within 16 hr the area indicated in Fig. 1 had caved over the 8-ft bolts to a height of some 15 ft. This meant that most of the rock from pillars 9 and 10 was not recovered, and to limit the caving pillars 6, 15, 22, 13, and 20 were not blasted. Fig. 7 shows the final form of the stope with all the pillars removed.

Fig. 8 is a typical vertical section marked 8-8 in Figs. 1 and 7. This section shows the effect of time on stope convergence after pillar removal and emphasizes the importance of moving through an area and out of it as rapidly as possible once pillar removal has begun.

Table I gives the results of a few tests made to determine physical properties of the rock from Baker 6100 stope, and Table II summarizes final results of the experiment in pillar recovery in this stope. In Table II the value for "area bolted per ton" can be further refined to give "area bolted per lb lead." This figure is a valuable characteristic of any specific stope area and is constant regardless of cost price of lead. It can be used for comparisons, therefore, in deciding which stope should be most profitable for pillar recovery. At any time this value can be multiplied by the current cost of bolting and the result compared with the current price of lead to determine whether or not pillar recovery in a specific area can be profitable.

CONCLUSIONS

1) Systematic roof bolting will safely permit pillar removal in limited areas.

2) Although the cost of pillar ore produced in this way is relatively high, when the method is applied to the better grade pillars the cost of lead produced is still lower than that of the average new ore now available.

3) High-strength, 3/4-in. headed bolts with ex-

pansion shells are equal or superior to presently used 1-in. slotted bolts, and much cheaper.

4) Roof bolting with a relatively simple bolting jumbo can raise the efficiency of present bolting efforts about five times.

5) Reasonable stope convergence and pillar loading can be detected and measured dependably by means of the extensometer, seismetron, and warning lights. General instability of the mine structure is quickly detectable by any or all of these instruments, although they are no substitute for experience and a scaling bar on small local areas of loose roof.

FUTURE PLANS

Fig. 9 shows the stope configuration specifically adapted to this type of pillar recovery by roof bolting. In this stope the ratio of area bolted to pillar ore (estimated) is 14.4 sq ft per ton. Systematic bolting also facilitates removing a limited number of high grade pillars in any large area, but the method is definitely limited and is not the answer to 100 pct recovery over large areas.

In the Lead Belt's very large pillar areas, some recovery method on the retreat with caving appears the only logical approach. But the roof rocks are not, in general, the type that will cave gradually or predictably, and it is thought that a form of induced caving to periodic lines of roof bolts might be employed. The situation is further complicated by towns on the surface only 200 to 500 ft over many of the mine areas. In these cases, delayed sand fill after initial caving has been considered as a possible means to control surface subsidence.

The author expresses appreciation to the St. Joseph Lead Co. for permission to publish this article, and to R. L. Bullock, J. J. Yancik, C. D. Mann, and Lee Bilheimer of the mine research department for the field work and preparation of drawings.

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Discussion of this article sent (3 copies) to AIME before Aug. 31, 1959, will be published in *MINING ENGINEERING*.

METEOROLOGICAL INFLUENCE ON RADON CONCENTRATION IN DRILLHOLES

by ALLAN B. TANNER

The effects of radon in drillholes on gamma-ray logs have been described by L. S. Hilpert and C. M. Bunker.¹ Since these effects may cause drastic error in the evaluation of uranium deposits, it is useful to know the conditions under which significant amounts of radon tend to accumulate in drillholes. In the studies described here, atmospheric conditions were found to dominate in the control of the behavior of radon in drillholes in the vicinity of a uranium orebody.

The site of the investigation was in McKinley County, New Mexico, about 12 miles north of Grants. Drillholes of 4¼-in. diam, on 25-ft and 100-ft centers, penetrate ore in dry rock at a depth of about 100 ft. A geologic log of the drillhole of primary interest is shown in Fig. 1. Gamma-ray logs revealed three zones of ore-grade mineralization in the Todilto limestone. A 6-ft zone, the lowest of the three, assayed 0.20 pct U_3O_8 by chemical analysis. The limestone ores in this area contain disseminated uraninite and some yellow and orange secondary minerals.

Only radon²²², a member of the uranium²³⁸ series, was measured in this investigation. Radon is one of the chemically inert noble gases and is radioactive by alpha particle emission with a half life of about four days. In this discussion, amounts of radon are expressed in microcuries (1 microcurie equals 37,000 disintegrations per sec) and concentrations of radon are expressed in microcuries per liter of drillhole air.

Samples of air were obtained by lowering a sampling device (Fig. 2) into a drillhole and actuating the device at the desired depth. It was then raised to the surface and the sample was transferred to a storage tube. Within two days the sample was transferred to an ionization chamber, and the activ-

A. B. TANNER is a Geophysicist with the Geophysics Branch of the U. S. Geological Survey, Salt Lake City. TP 4804L. Manuscript, Nov. 28, 1958. New York Meeting, February 1958. AIME Trans., Vol. 214, 1959.

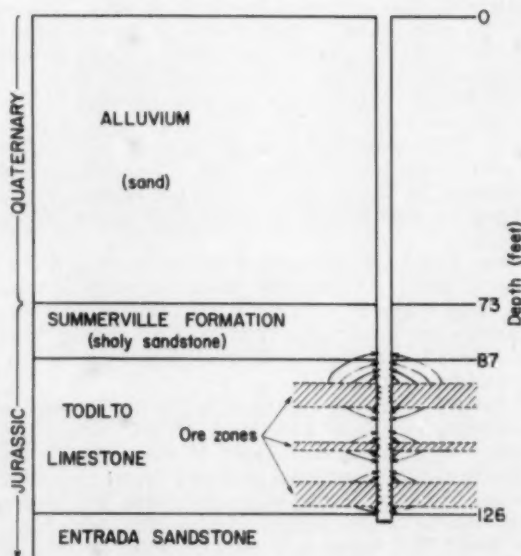


Fig. 1—Probable paths of radon movement in drillhole.

ity of radon and its short-lived daughter products was measured at radioactive equilibrium with a vibrating-reed electrometer. The measurements were corrected back to the time of collection and involve errors estimated generally not to exceed +5 pct to -15 pct.

Radon Behavior in a Covered Hole: Fig. 3, a typical log of radon concentration vs depth in the covered drillhole, was made by using values of radon concentration at discrete depths. Continuous logs of alpha-particle radiation in the drillholes showed that such radon logs depict the continuous variation of radon concentration with depth quite accurately. Three features of radon logs were noted: 1) maximum

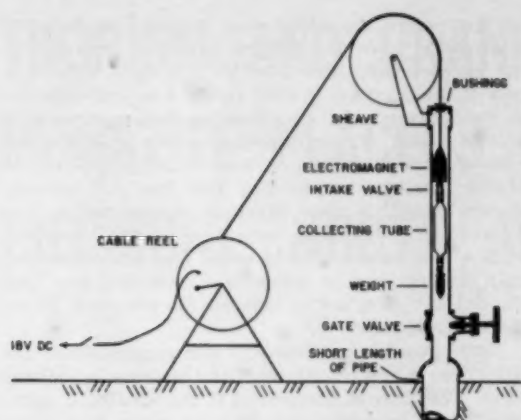


Fig. 2—System for sampling air in drillholes.

concentration, 2) depth corresponding to the maximum concentration, and 3) total amount of radon in the hole. Maximum concentration and its corresponding depth were found by inspection of the log. Total amount of radon in the hole was found by making a graphical summation of the area under the curve of radon concentration vs depth and making the appropriate dimensional conversion. All three features changed considerably from day to day.

Fig. 4 is a plot of atmospheric pressure and the total radon content of the covered hole vs time. Cross hatching marks two periods when the cover was removed in order to determine the effect of moderate wind on the radon content of the hole. For several months before and during the other parts of the 20-day investigation of this hole it was covered. The meteorological data for the period were obtained from continuous-recording instruments housed only a few feet away.

Symmetry is evident between the curve of atmospheric pressure vs time and the curve of total radon content vs time. The total radon-content curve appears to be approximately a mirror image of the pressure curve, suggesting an inverse relation between the two quantities. After inversion and scale change, the total radon-content curve has the shape of the upper dashed line on Fig. 4. To facilitate comparison of the curves the lower dashed line has been drawn, showing the relative pressure changes between series of radon measurements. The curves closely parallel each other for eight of the nine intervals between measurements.

Although the results in Fig. 4 show a fairly consistent relation between changes in atmospheric pressure and changes in total radon content of the hole, it must be noted that strict inverse proportionality between pressure and total radon content was not observed. At four different times when the atmospheric pressure was 601 mm of mercury, the values for total radon content were 129, 103, 86, and 148 microcuries. The inferences drawn from these data seem to be valid for day to day changes only.

During the periods shown by cross hatching on Fig. 4, the covering system was removed. The first period was 1 hr, during which 26 miles of air passed the wind-measuring instrument at a height of 6 ft. Analyses of air from the hole before and after the exposure to wind indicated a drop in total radon con-

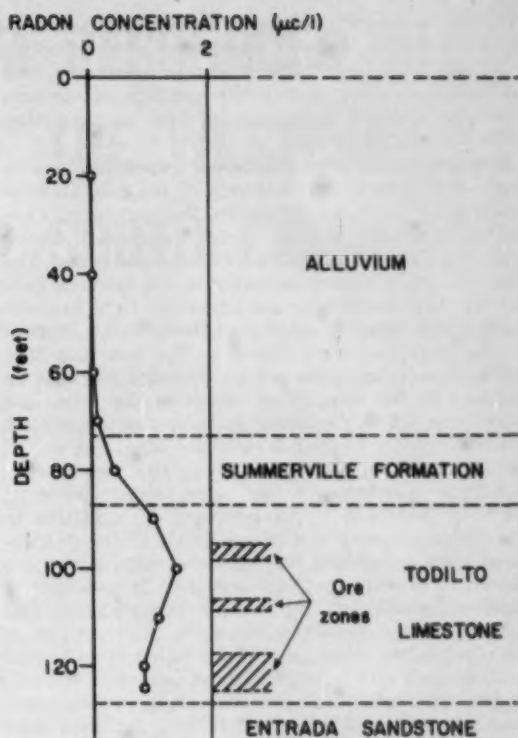


Fig. 3.—Typical log of radon concentration.

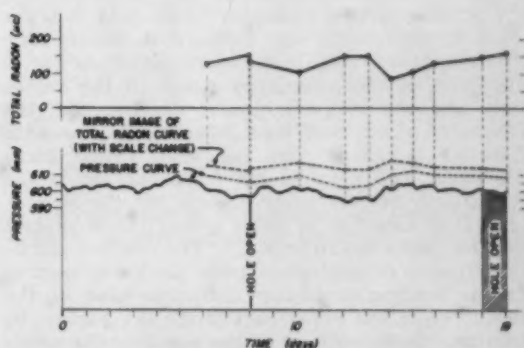


Fig. 4. Radon variation in covered hole.

tent from 153 to 134 microcuries. The second period was 24 hr, during which 118 miles of air passed the wind-measuring instrument, the wind speed averaging 14 miles per hr for the last 4 hr. During this latter period the wind did not greatly affect the total radon content, which increased from 148 to 160 microcuries, coincident with a drop in atmospheric pressure. There was marked reduction in radon concentrations to a depth of 60 ft as a result of the wind. Radon concentrations at depths of 80 ft and greater were not diminished.

No relation was observed between surface temperature or wind direction and any of the characteristics of the radon logs. Because wind velocity and temperature extremes were reliable, days on which only temperature characteristics varied were not found. Calculation shows that the maximum

effect of temperature change upon radon concentration through thermal expansion or contraction could not have been more than 8 pct, however, and probably not more than a few percent, in contrast with the changes by factors of two or more that were actually observed.

Mechanism of Radon Migration: Experimental evidence and theoretical treatment of the migration of radon have led to the conclusion that diffusion is not the mechanism whereby large amounts of radon migrated from uraniferous rock into drillholes. The observations of radon behavior in the covered hole indicate that surface temperature and light to moderate winds did not affect significantly the amount or the distribution of radon in the hole but that decreasing atmospheric pressure tended to cause an increase in the amount of radon in the hole, and conversely. If this relation is true, the mechanism whereby radon tended to migrate into and out of the drillhole is easy to deduce. The ore-bearing limestone undoubtedly has some minor porosity, some of which is interconnecting. In addition to this minor porosity and permeability of the unfractured rock, numerous fractures and silty layers are known to exist in the rock and may be assumed to add appreciably to its overall permeability and porosity. There should be, then, an air reservoir in the ore-bearing rock, into which radon is emanated at a constant rate from its radium parent in the ore. Under the influence of decreasing atmospheric pressure, transmitted through the drillhole and along paths of greatest permeability, the air in the reservoir should expand, moving into the hole and carrying radon with it. Once in the hole, the influent air should mix with the air already in the hole and produce a larger amount of air with a lower radon concentration. An increase in atmospheric pressure should result in the movement of air—with only part of the undecayed radon in the hole—back into the rock. A similar phenomenon, the movement of air from rock into tunnels, has been observed in mines and has been called earth breathing. The path of movement of air to the drillholes is not definitely known, but the characteristics of variation in radon concentration suggest the flow paths shown in Fig. 1. The relative stability of radon concentration from the lower part of the ore horizon downward indicates most of the flow to be in the upper part of the ore horizon or from the upper surface of the ore into the overlying Summerville formation and thence into the drillhole. The path cannot be uniquely resolved from the evidence available.

Radon Behavior in an Open Hole: Several other drillholes were investigated. A more limited series of analyses was made on air samples from one of these holes, which was always open. There was much greater variation in radon behavior in this hole than in the one first described. Radon concentrations at given depths in the hole varied by as much as $4\frac{1}{2}$ orders of magnitude. The depth corresponding to the maximum concentration was sometimes at surface and sometimes at the ore horizon. Total radon in the hole varied between 220 microcuries and 0.5 microcurie. Wind speed and atmospheric pressure both appear to have had important effects on the behavior of radon in the hole. The most noticeable of these effects was a great reduction in the amount of radon in the hole on a day of strong wind—in one day the amount of radon decreased from about 200 microcuries to

0.5 microcurie. Assuming that the relation between total radon and atmospheric pressure inferred for the covered hole was true for the open hole also, part of the decrease in total radon was probably due to an observed rise in atmospheric pressure. It is unlikely that pressure change alone was responsible for the decrease, as a similar rise in atmospheric pressure on another day was not accompanied by such a great decrease in total radon. It is believed that the wind, blowing over the open hole from 4 to 6 hr at 25 to 35 mph, was more effective than the increase in pressure in reducing the total amount of radon in the hole by the observed factor of about 400.

Three possible mechanisms are suggested for the reduction in radon content of the hole by strong wind. The first of these is that this drillhole, combined with underground flow channels and other drillholes, acted as a venturi tube system of some sort and that minor pressure differentials arose because of the relief of the ground into which the holes were drilled and over which the wind was moving. Considering the relative planeness of the ground, this possibility does not seem likely. The second possibility is that the strong wind caused turbulence in the drillhole that accelerated dilution of the drillhole air by air from the surface. The third possibility is that the wind was strong enough to excite the air column in the hole as in a closed organ pipe having a fundamental frequency of two to three cycles per second. Considerable turbulence would arise with such oscillations in an irregular drillhole and would promote diffusion of radon through the air in the hole more rapidly than under quiescent conditions.

Since the wind speed was appreciably higher at the open hole on the windy day than during the 24-hr period when the covered hole was uncovered, the lack of evidence of great reduction in total radon in the covered hole during that period does not necessarily contradict the inference that strong winds were capable of greatly reducing the radon content of drillholes. Light and moderate winds do not appear to have had much influence on radon concentrations in the open hole, even near surface, as the maximum concentration, seven orders of magnitude greater than that usually found in the atmosphere, was observed at the surface over a hole on a day when winds were 5 to 10 mph. As with the covered hole, no relation was noted between surface temperature and radon behavior in the open hole.

Acknowledgment is made to F. O. Manol and I. Rapaport of Four Corners Exploration Co. and to E. B. Butts, A. W. Callahan, and P. Melancon of Holly Minerals Corp. for furnishing information about the drillholes. The Grants Airway Communications Station of the Civil Aeronautics Administration, Department of Commerce, furnished some of the meteorological data. R. H. Barnett, of the USGS, developed the apparatus used to obtain continuous logs of alpha-particle radiation in the holes. This work was performed by the USGS in behalf of the Division of Research of the U. S. Atomic Energy Commission.

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Discussion of this article sent (2 copies) to AIME before Aug. 31, 1959, will be published in *MINING ENGINEERING*.

THORIUM AND URANIUM RESOURCES IN MONAZITE PLACERS OF THE WESTERN PIEDMONT, NORTH AND SOUTH CAROLINA

by WILLIAM C. OVERSTREET, PAUL K. THEOBALD, JR., and JESSE W. WHITLOW

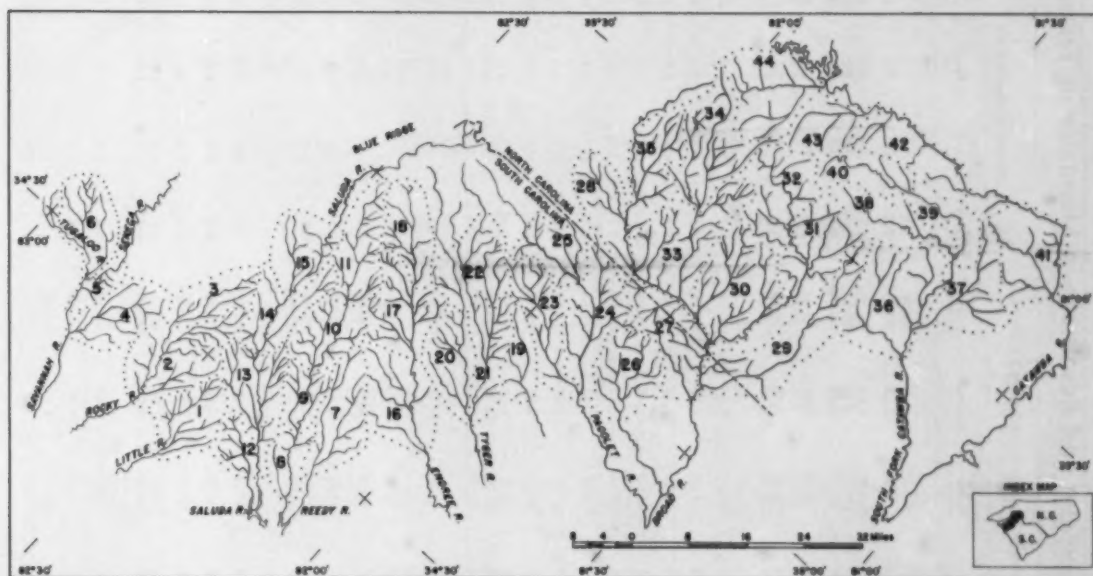


Fig. 1—Locations of the 44 drainage basins appraised for placer monazite between the Savannah and Catawba rivers, S. C. and N. C. Numbers in outlined areas correspond to those preceding drainage basins in Tables IA-ID.

Monazite placers in a region of the Carolinas explored in 1951-1954 by the USGS are estimated to contain at least 53,000 short tons of thorium and 4600 short tons of uranium. None of these deposits is being mined.

The 5200-sq mile area investigated extends northeast along the western Piedmont from the Savannah River in South Carolina to the Catawba River in North Carolina. Much of the region is 700 to 1100 ft above sea level. Gentle hills and broad interfluvies give a local relief of 100 to 200 ft. This increases to 1700 ft at the west margin of the area where the east flank of the Blue Ridge is approached in South Carolina and the South Mts. are entered in North Carolina.

This report is restricted to placers in the Piedmont. Monazite deposits in the Blue Ridge and coastal plain were not covered by the investigation.

W. C. OVERSTREET; P. K. THEOBALD, JR.; and J. W. WHITLOW are, respectively, with the U. S. Geological Survey in Beltsville, Md.; Denver, Colo.; and Knoxville, Tenn. TP 4807H. Manuscript, July 10, 1958. AIME Trans., Vol. 214, 1959.

Monazite Mining in the Carolina Piedmont: Discovered in 1879 by W. E. Hidden,¹ the monazite placers in the Carolina Piedmont were first mined in 1886. The area was a major world source for thorium and the lanthanides until 1895, when Brazilian monazite entered the trade. Total output from the Carolina Piedmont has been nearly 5500 tons of monazite,² but the placers have been idle since 1911, except for 48 tons produced between 1915 and 1917.

Monazite mining was revived in the Carolinas in 1954 when a dredge operated by the Heavy Minerals Co. opened a fluvialite placer along Horse Creek in the coastal plain near Aiken, S. C.

Geology and Mineralogy: Two recent papers^{3, 4} have described the geology of the monazite placer district in the Piedmont between the Savannah and Catawba rivers; the general geology of the region has been reviewed by P. B. King.⁵ These reports show that the placers are in locally derived alluvial sediments that cover the floors of shallow, narrow valleys in an area underlain by monazite-

Table I. Volume, Composition, and Tenor of Alluvium and Resources in Monazite in Tributary Drainage Basins

	IA River Basins	Estimated Volume of Sediment Explored, Million Cu Yd				Tenor, Lb per Cu Yd				Estimated Resources in Monazite, Million Lb			
		Clay	Silt and Sand	Gravel	Total	Clay	Silt and Sand	Gravel	Weighted Average	Clay	Silt and Sand	Gravel	Total
Savannah River, S. C. (Appraised by D. W. Caldwell, 1952-1953)													
1.	Hopkinn Creek and other tributaries to Little River, Anderson and Abbeville counties, S. C.	9.15	13.56	2.30	25.01	0.3	1.5	2.8	1.2	3.24	20.93	6.36	30.53
2.	Broadway Creek and other streams entering Rocky River, Anderson County, S. C.	20.92	35.47	5.94	62.33	0.1	0.6	0.8	0.5	2.72	22.49	4.06	30.17
3.	Big Beaverdam Creek, Anderson County, S. C.	19.77	27.43	3.19	50.39	0.01	0.2	0.2	0.1	0.28	4.54	0.75	5.57
4.	Big Beaverdam Creek, Anderson County, S. C.	8.38	32.38	3.65	44.41	0.1	0.5	1.1	0.5	1.06	17.62	4.06	23.74
5.	Saddle Creek and small tributaries to Savannah and Seneca Rivers, Anderson County, S. C.	0.99	2.26	0.57	3.82	0.6	2.2	3.7	2.0	0.59	5.07	2.12	7.78
6.	Big Beaverdam and Little Beaverdam Creeks, Anderson and Oconee counties, S. C.	17.15	28.28	4.79	50.22	0.2	0.6	1.3	0.5	2.64	17.49	6.00	26.11
	Totals and averages, basins tributary to Savannah River	76.36	139.38	20.44	236.18	0.1	0.6	1.2	0.5	10.53	88.14	24.25	122.92
Saluda River (Appraised by D. W. Caldwell, 1952-1953)													
7.	Rabon Creek, Greenville and Laurens counties, S. C.	20.08	35.57	5.30	60.95	0.1	0.5	0.9	0.4	2.19	18.17	4.80	25.16
8.	Walnut Creek and other tributaries to Reedy River, Laurens County, S. C.	1.80	4.02	0.96	6.80	0.1	0.5	1.1	0.5	0.25	2.20	1.05	3.50
9.	Horse Creek and neighboring streams joining Reedy River, Greenville and Laurens counties, S. C.	7.18	12.49	1.96	21.63	0.1	0.3	0.8	0.3	0.76	3.59	1.02	5.97
10.	Huff Creek and other streams entering Reedy River, Greenville County, S. C.	3.71	11.03	2.19	16.93	0.5	2.3	3.8	2.1	1.93	25.58	8.33	35.84
11.	Little Creek and adjoining tributaries to Reedy River, Greenville County, S. C.	8.68	17.14	3.71	29.53	0.2	1.0	1.6	0.8	1.87	17.74	5.76	25.37
12.	Turkey Creek and other tributaries to Saluda River, Anderson, Abbeville, and Laurens counties, S. C.	4.39	8.68	1.51	14.58	0.2	0.7	1.4	0.6	0.77	6.18	2.08	9.03
13.	Broad Mouth Creek and nearby streams entering Saluda River, Anderson, Greenville, Abbeville, and Laurens counties, S. C.	10.56	20.21	3.38	34.15	0.2	1.0	1.8	0.8	2.46	19.97	6.26	28.69
14.	Grove Creek and other tributaries to Saluda River, Anderson and Greenville counties, S. C.	10.91	20.37	3.65	34.93	0.07	0.4	0.7	0.3	0.75	7.69	2.68	11.10
15.	Big Brushy Creek and adjoining streams tributary to Saluda River, Anderson and Greenville counties, S. C.	8.23	14.37	2.50	25.10	0.02	0.2	0.3	0.2	0.16	2.84	0.85	3.85
	Totals and averages, basins tributary to Saluda River	75.54	143.88	25.18	244.60	0.1	0.7	1.3	0.6	11.14	103.96	33.41	148.51
18 River Basins													
Enoree River, S. C. (Appraised by N. P. Cuppels, 1952-1953)													
16.	Durbin Creek and other tributaries to Enoree River, Laurens, Spartanburg, and Greenville counties, S. C.	14.41	37.73	3.32	55.46	0.1	0.3	0.6	0.3	1.63	10.76	2.11	14.50
17.	Gilder Creek and adjoining streams tributary to Enoree River, Spartanburg, Greenville, and Laurens counties, S. C.	11.27	33.22	4.48	48.97	0.3	1.3	2.5	1.2	3.51	43.97	11.11	58.59
18.	Mountain Creek and adjacent streams entering Enoree River, Greenville County, S. C.	6.18	13.74	2.64	22.56	0.1	0.5	1.0	0.4	0.85	8.79	2.68	10.32
	Totals and averages, basins tributary to Enoree River	31.86	84.69	10.44	126.99	0.2	0.7	1.5	0.7	5.99	61.52	15.90	83.41
Tyger River, S. C. (Appraised by N. P. Cuppels, 1952-1953)													
19.	Beaverdam Creek and other tributaries to Fairforest Creek, Spartanburg County, S. C.	8.07	20.43	3.07	31.57	0.2	0.6	1.1	0.5	1.30	11.26	3.36	15.82
20.	Ferguson Creek and other streams tributary to South Tyger River, Spartanburg County, S. C.	13.18	34.10	3.00	50.28	0.1	0.4	0.9	0.4	1.50	14.42	2.83	18.75
21.	Junction of North Tyger River, Middle Tyger River, and adjoining streams, Spartanburg County, S. C.	26.82	48.51	3.88	79.21	0.1	0.6	1.1	0.4	3.16	28.26	4.19	35.61
22.	Parts of North Tyger River, Middle Tyger River, South Tyger River, and tributaries, Spartanburg and Greenville counties, S. C.	16.13	27.36	2.94	46.43	0.1	0.5	0.8	0.4	1.74	14.55	2.21	18.50
	Totals and averages, basins tributary to the Tyger River	64.20	130.40	12.89	207.49	0.1	0.5	1.0	0.4	7.70	66.49	12.49	88.68
Pacolet River, S. C. (Appraised by N. P. Cuppels, 1952-1953)													
23.	Lawson Fork Creek, Spartanburg County, S. C.	11.13	31.21	4.03	46.37	0.2	0.8	1.6	0.7	2.35	26.04	6.33	34.72
24.	Buck Creek and other tributaries to Pacolet River, Spartanburg and Cherokee counties, S. C.	14.25	47.78	7.27	69.30	0.5	1.4	3.1	1.4	6.75	66.83	22.50	96.17
25.	Junction of North Pacolet River, South Pacolet River, and adjoining streams, Spartanburg County, S. C.	20.80	46.05	8.13	74.98	0.08	0.4	0.8	0.4	1.69	19.54	6.47	27.70
	Totals and averages, basins tributary to Pacolet River	46.18	125.04	19.43	190.65	0.2	0.9	1.8	0.8	10.79	112.41	35.39	158.59

Table I. Volume, Composition, and Tenor of Alluvium and Resources in Monazite in Tributary Drainage Basins (Continued)

	IC River Basins	Estimated Volume of Sediment Explored, Million Cu Yd				Tenor, Lb per Cu Yd				Estimated Resources in Monazite, Million Lb			
		Clay		Gravel		Clay	Silt and Sand		Gravel	Clay	Silt and Sand		Gravel
		Total	Weighted Average	Total	Weighted Average		Total	Weighted Average			Total	Weighted Average	
Broad River, S. C.-N. C. (Appraised by F. K. Theobald, Jr., A. M. White, J. W. Whitlow, and W. C. Overstreet, 1951-1953)		21.90	32.20	4.95	59.04	0.3	1.1	2.5	0.9	5.04	36.30	13.40	54.54
26. Thickety Creek, Cherokee and Spartanburg counties, S. C.		0.26	18.33	2.75	120.03	0.4	2.1	3.3	0.7	4.24	36.04	9.19	85.57
27. Cherokee Creek and other tributaries to Broad River, Spartanburg and Cherokee counties, S. C.; Rutherford and Cleveland counties, N. C.		2.82	11.20	1.26	15.38	0.07	0.4	0.7	0.5	0.21	4.20	0.89	7.20
28. McKinney Creek and other southern tributaries to Broad River, Polk and Rutherford counties, N. C.		17.23	70.31	13.47	101.01	0.3	0.9	1.8	0.9	4.82	61.52	24.04	90.40
29. Buffalo Creek and Bowen River, Cleveland and Lincoln counties, N. C.; Cherokee County, S. C.		18.04	41.00	6.79	82.20	0.5	2.0	4.1	1.6	8.23	63.82	26.11	132.76
30. Sandy Run, Brushy Creek, and Beaverdam Creek, Cleveland and Rutherford counties, N. C.		0.60	25.04	0.11	4.85	0.6	2.4	4.1	2.3	2.78	56.00	27.64	90.02
31. Kyles Creek and other tributaries to First Broad River, Cleveland County, N. C.		7.72	37.81	12.73	58.36	0.3	1.3	2.2	1.3	2.43	48.44	27.51	78.38
32. Hinton Creek and adjacent streams entering First Broad River, Rutherford and Cleveland counties, N. C.		12.19	36.76	7.01	75.92	0.4	1.3	2.6	1.1	4.97	47.40	18.44	85.45
33. Floyd Creek and neighboring tributaries to Broad River, Rutherford County, N. C.		19.57	61.93	14.62	105.04	0.3	0.8	1.2	0.7	3.52	40.18	16.18	72.78
34. Cathey Creek and adjoining streams tributary to Second Broad River, Rutherford and Cleveland counties, N. C.		5.27	21.60	2.36	29.23	0.1	0.5	0.9	0.5	0.51	11.02	2.10	13.63
35. Mountain Creek and other tributaries to Broad River, Rutherford County, N. C.		121.04	346.40	71.41	680.06	0.3	1.3	2.4	1.0	38.85	432.72	168.50	711.81
Totals and averages, basins tributary to Broad River		(a)	(a)	(a)	(a)	(c)	(c)	(c)	(d)	(a)	(a)	(a)	(c)
(a) Incomplete sum.													
(b) Includes 69,870,000 cu yd of undifferentiated sediment containing 34.1 million lb of monazite along Broad River.													
(c) Tenor for part of total alluvium.													
(d) Tenor for total alluvium.													
(e) Includes 1.9 million lb of monazite in 3,530,000 cu yd of sediment for which the tenor was not calculated for kind of sediment.													
(f) Includes 16,370,000 cu yd of undifferentiated sediment having 12.6 million lb of monazite along First Broad River.													
(g) Includes 5,410,000 cu yd of undifferentiated sediment containing 3.8 million lb of monazite along First Broad River.													
(h) Includes 19,960,000 cu yd of undifferentiated alluvium containing 14.64 million lb of monazite along Second Broad River and Broad River.													
(i) Includes 8,950,000 cu yd of sediment with 3.60 million lb of monazite along Second Broad River.													
ID													
River Basins													
Catawba River, N. C. (Appraised by A. M. White, 1932-1933)		16.79	44.97	6.39	138.15	0.3	1.2	2.2	0.8	4.44	54.67	13.95	103.06
Indian Creek and other tributaries to the South Fork Catawba River, Lincoln, Catawba, and Gaston counties, N. C.		9.33	39.43	4.51	53.07	0.1	0.4	0.9	0.4	1.03	17.54	2.43	22.00
37. Clark Creek, Catawba and Lincoln counties, N. C.		6.94	19.78	4.26	30.98	0.1	0.9	1.9	0.6	1.03	17.21	8.15	36.29
38. Jacob Creek and adjoining streams, Burke, Catawba, Cleveland, and Lincoln counties, N. C.		6.36	19.50	2.80	28.66	0.2	1.1	1.9	1.0	1.37	20.84	8.19	27.40
39. Downstream part of Henry Fork, Burke and Catawba counties, N. C.		1.63	5.63	0.62	7.29	0.2	0.7	1.1	0.6	0.16	2.75	0.66	4.57
40. Laurel Creek and neighboring tributaries to Henry Fork, Burke County, N. C.		8.44	39.06	4.83	52.33	0.08	0.3	0.5	0.4	0.06	10.56	2.22	22.70
41. Lyle Creek and adjacent streams entering Catawba River, Catawba County, N. C.		3.14	10.26	1.46	14.93	0.2	0.8	1.2	0.7	0.53	8.62	1.94	11.09
42. Hunting Creek and other tributaries to Catawba River, Burke County, N. C.		11.44	24.87	3.10	39.41	0.2	1.0	1.7	0.8	2.35	25.70	5.27	33.42
43. Silver Creek, Burke County, N. C.		14.36	37.53	6.46	58.27	0.1	0.7	1.1	0.6	2.11	24.49	6.93	37.03
44. Muddy Creek and Shadrick Creek, McDowell County, N. C.		77.85	241.10	34.25	413.20	0.3	0.8	1.4	0.7	12.08	183.38	47.84	287.66
Totals and averages, basins tributary to Catawba River		(a)	(a)	(a)	(a)	(c)	(c)	(c)	(d)	(a)	(a)	(a)	(c)
(a) Incomplete sum.													
(b) Includes 60,000,000 cu yd of alluvium with 30.9 million lb of monazite along South Fork Catawba River.													
(c) Tenor for part of total alluvium.													
(d) Tenor for total alluvium.													
(e) Includes 23,490,000 cu yd of sediment for which tenor was not calculated for kind of sediment.													
(f) Includes 3,960,000 cu yd of sediment for which tenor was not calculated for kind of sediment.													

Table II. Comparison of Tenors in Monazite Estimated by Reconnaissance and by Churn Drilling

Flood Plain	Reconnaissance Appraisal by USGS		Exploration with Churn Drill by USBM		Reference Number
	Re-sources, Lb Per Cu Yd	Inferred, Lb Per Cu Yd	Indicated, Lb Per Cu Yd		
Knob Creek, N. C.	2.0	—	1.67		6
Buffalo Creek, N. C.	1.1	—	1.25		7
South Muddy Creek, N. C.	0.8	0.6	0.64		9
Silver Creek, N. C.	1.0	0.6	0.83		9
North Tyger and Middle Tyger Rivers, S. C.	0.3	0.4	—		11
Hinton Creek, N. C.	1.2	0.72	—		10
Wards Creek, N. C.	1.2	0.72	—		10

bearing metamorphic and igneous rocks. The monazite-bearing metamorphic rocks are a stratigraphic sequence of unknown age which was metamorphosed to biotite gneiss and sillimanite-almandine schist in Ordovician time. Intruded into these metamorphic rocks are monazite-bearing conformable masses of quartz monzonite and pegmatite and cross-cutting bodies of monazite-free quartz monzonite, pegmatite, and diabase.

The stream sediments are well bedded, poorly graded, and unconsolidated and of similar stratigraphy from the Savannah to the Catawba rivers. They are deposited on deeply weathered flat valley floors in successive sheetlike layers of differing lithology. The lowermost layer is quartz-pebble gravel with a matrix of sandy clay. Overlying the gravel, or resting on bedrock where gravel is absent, is dense gray clay. Quartz pebbles and fragments of carbonized wood are scattered through the clay, which grades locally into peat or muck. Above the clay is coarse to fine-grained gray, buff, or brown sand overlain by buff, brown, or gray clayey silt. The uppermost sediment is red to brown sandy silt. Average thickness of the sediments is 14.6 ft. The layer of gravel at the bottom of the deposits averages 1.5 ft thick, the layer of clay is about 3.6 ft, and the sand and silt about 9.5 ft thick. The deposits are of Recent age, except for small areas of pre-Wisconsin sediment in the heads of some streams. The uppermost red to brown sandy silt has been deposited since the region was cleared for agriculture in the nineteenth century.

Table III. Resources of Monazite and Zircon in the Forty-Four Drainage Basins Between the Savannah and Catawba Rivers

Drainage Basin	Volume of Sediment Explored, Million Cubic Yards	Estimated Average Tenor, Lb Per Cu Yd		Estimated Resources, 1000 Short Tons	
		Monazite*	Zircon	Monazite*	Zircon
Savannah River (in South Carolina)	236.2	0.5	0.4	59	47
Saluda River	244.6	0.6	0.2	73	24
Enoree River	127.0	0.7	0.1	44	6
Tyger River	207.5	0.4	0.6	42	62
Pacolet River	190.6	0.8	0.4	76	36
Broad River	690.1	1.0	0.4	345	136
Catawba River (southern tributaries)	413.2	0.7	0.4	145	83
	2,109.2	0.8	0.4	784	396

* Includes xenotime.

Individual flood plains in the Piedmont monazite district are rarely more than 2 or 3 miles long. Each is separated from the next upstream or downstream flood plain by short narrows, shoals, or rocky ledges. These flood plains are 10 ft to 2500 ft wide and range in area from several thousand square yards to 7 million sq yd. In about half the valleys they reach 200 to 800 ft in width and exceed 1 million sq yd in area. However, the small flood plains at the extreme heads of creeks, which were the traditional sites of monazite mining, are only a few hundred to about 200,000 sq yd in area, and the volume of sediment in the smallest of these is no greater than a few hundred to a few thousand cubic yards. The largest flood plain in the area contains 60 million cu yd of sediment. Average is about 7 million cu yd. Among the hundreds of individual flood plains in the area the USGS classed 84 as monazite placers. Eight of these contain less than a million cubic yards of sediment, 39 have between 1 and 5 million cu yd, 19 have from 5 to 10 million cu yd, and 18 more than 10 million cu yd. Average volume of fill in these 84 flood plains is 6.8 million cu yd of sediment.

Tenors of the flood plain sediments range from less than 0.1 lb to 50 lb of monazite per cu yd and less than 0.1 lb to 30 lb of zircon per cu yd. Average tenor throughout the area is 0.8 lb of monazite and 0.4 lb of zircon per cu yd of sediment. Among the 84 flood plains classed as placers the average tenor is 1.3 lb of monazite and 0.6 lb of zircon per cu yd of sediment.

Highest tenors are in the coarsest-grained, lowest sediments in the flood plains and are in the smallest headwater deposits.

Monazite, the chief thorium-bearing and uranium-bearing mineral in the deposits, ranges in abundance from 1 to 80 pct of the concentrate and commonly makes up 10 to 30 pct. Monazite from placers in North and South Carolina and Georgia was shown by John B. Mertie, Jr.,⁸ to average 5.67 pct ThO₂ and 0.38 pct U₃O₈ in 53 samples. Similar percentages were reported by the USBM¹² in analyses of 19 samples of placer monazite from North and South Carolina. Average values for thorium and uranium in placer monazite in the drainage basins from the Savannah to the Catawba rivers are:

River Basin	Number of Analyses	ThO ₂ , Pct	U ₃ O ₈ , Pct
Savannah (in South Carolina)	1	4.21	0.44
Saluda	8	5.96	0.39
Enoree	1	5.56	0.55
Tyger	2	5.77	0.70
Pacolet	4	5.04	0.52
Broad	47	5.94	0.41
Catawba (southern tributaries)	6	4.39	0.39

Other thorium-bearing and uranium-bearing minerals noted in the concentrates include zircon, xenotime, sphene, and unidentified radioactive opaque minerals. Zircon, found in about 65 pct of the samples of alluvium, makes up 1 to 50 pct of the concentrate and ordinarily constitutes 1 to 10 pct of the heavy minerals. It is concluded from study of 1200 heavy-mineral concentrates from crystalline rocks in the region that zircon in the placers is derived chiefly from the schists, but that possibly 20 pct comes from granitic rocks and pegmatite. Laboratory studies of zircon from this area¹¹ suggest that the placer zircon contains about 0.01 pct ThO₂ and 0.04 pct U₃O₈.

Xenotime is not abundant. It constitutes 20 pct of the heavy minerals in two samples and 1 pct of the concentrates from samples in 27 small areas. Elsewhere it is present but is less than 1 pct of the concentrate. Xenotime from a tributary to the Catawba River is reported¹⁰ to contain a trace of thorium and 4.26 pct U_3O_8 , and xenotime from a tributary to the Broad River has 0.20 pct ThO_2 and 1.40 pct U_3O_8 .

Sphene, which in some specimens contains thorium and uranium, was found in concentrates from nine localities. At no place did it make up more than 3 pct of the concentrate; hence it is not a source of thorium or uranium in this region. The largest sphene-bearing area is a zone a mile wide and 12 miles long crossed by tributaries to the Catawba River in the extreme northeastern part of the region.

Unidentified radioactive opaque minerals make up less than 0.1 pct of the heavy minerals in tributaries to the Catawba River⁹ and in several tributaries to the Broad River.^{10, 11} Minor amounts of fergusonite, gadolinite, and euxenite have been detected in concentrates from the monazite placers and reported in older literature,^{1, 12} but they are mineralogical curiosities and contribute practically nothing to the amount of thorium and uranium in the placers.

RESOURCES

Monazite and Zircon: The resources of monazite and zircon in the stream sediments were appraised by reconnaissance methods. For the appraisal the streams were grouped into 44 drainage basins (Fig. 1). Margins of individual flood plains in each drainage basin were interpreted stereoscopically on 1:20,000 scale aerial photographs, which were compiled into uncontrolled mosaics. After field check of the interpretation the areas of the flood plains were measured by polar planimeter. At a scale of 1:20,000 a deviation of 0.03 sq in. in the measured area represents an error of 10,000 sq yd in the estimated area of the flood plain. Accuracy of planimetry within 5 pct of the area was achieved for flood plains having an area of 200,000 sq yd. Accuracy of planimetry equal to 1 pct of the area was achieved for flood plains having an area of 1 million sq yd. Nearly half of the flood plains exceed 1 million sq yd in area. A comparison between areas of three flood plains mapped by photo interpretation and the same flood plains mapped by plane table and tele-

scopic alidade showed differences in area, assuming the plane table map to be the more accurate and the planimetry to be the same, of -7.5 pct, +6.1 pct, and +4.2 pct.

Average depth of alluvium in each flood plain was estimated from stratigraphic measurements of exposed flood plain sediments and from holes made with a jeep-mounted auger drill. Sediments were classed as clay, silt and sand, and gravel. A weighted average thickness of each class of sediment was allocated to every flood plain. The weighted average thickness of a class of sediment in a flood plain was estimated by assigning areas of influence to auger holes and stratigraphic measurements and weighting the individual thicknesses by the area factor. In a check of 51 flood plains where geologists estimated thickness of flood plain sediments by stratigraphic measurements and where the flood plains were subsequently augered, it was found that two estimates were in error by 67 pct and that the algebraic average error was an overestimate of slightly less than 10 pct.

The amount of monazite and other heavy minerals in the sediment was estimated by the USGS party from microscopic study of heavy minerals panned from 2672 samples of sediment. The samples, totaling nearly 110,000 lb, were distributed among all the classes of sediment and were taken between the top and bottom of the flood plain at intervals controlled by changes in lithology. A weighted average tenor for each class of sediment in every flood plain was calculated by attributing areas of influence to the samples. The weighted average tenor of each class of sediment multiplied by the volume of that class gave the estimated weight of monazite in that class of sediment in the flood plain. The sum of the weights of monazite in each class of sediment gave the amount of monazite in the flood plain. The estimated volume of sediment and weight of monazite in one drainage basin are the sums of the values for the individual flood plains in the basin.

A study made of the recovery of heavy minerals by panning was reported by Theobald,¹⁷ who showed that average recovery of monazite was 84 pct and of zircon 72 pct of the amount in the sample of sediment. Recovery ranged from a low of 35 pct of the monazite and 12 pct of the zircon in some samples of clay and silt to a high of 94 pct of the monazite and 100 pct of the zircon in some samples of gravel.

Table IV. Resources of Thorium and Uranium in Explored Alluvial Monazite Deposits Between Savannah and Catawba Rivers, S. C.-N. C.

Drainage Basin	Monazite*					Zircon				
	Short Tons	ThO_2		U_3O_8		Short Tons	ThO_2		U_3O_8	
		Pct	Short Tons	Pct	Short Tons		Pct	Short Tons	Pct	Short Tons
Savannah River (in South Carolina)	59,000	4.21	2,000	0.44	300	47,000	4.7		Estimated 0.01	18.8
Saluda River	73,000	5.96	4,000	0.39	300	24,000	2.4			9.6
Enoree River	44,000	5.56	2,000	0.55	200	6,000	0.6			2.4
Tyger River	43,000	5.77	2,000	0.70	300	62,000	6.2			24.8
Facotet River	76,000	5.04	4,000	0.52	400	38,000	3.8			15.2
Broad River	345,000	5.94	20,000	0.41	1,400	138,000	13.8			55.2
Catawba River (southern tributaries)	145,000	4.39	6,000	0.39	600	83,000	8.3		Estimated 0.04	33.2
Total	784,000		40,000		3,500	398,000	39.8			158.2

* Includes traces of xenotime.

The panned concentrates were examined mineralogically in the USGS laboratories by a staff directed by Jerome Stone, who devised the routine followed in the laboratory.¹⁵ The panned concentrates, without processing in heavy liquids, were sized into three to five sieve fractions. The sieve fractions were weighed and a split of 100 to 150 mineral grains was made from each fraction. The grains were identified microscopically and counted. For one concentrate the total number of grains counted ranged from 300 to 750 and averaged 400. Numerical frequencies of each mineral in each sieve fraction were converted to weight percents by appropriate specific gravity factors. The weight percent of each mineral in the separate sieve fractions from one concentrate was recalculated according to the weight of each sieve fraction to give the weight percent of each mineral in the concentrate. The estimated weight of monazite or zircon in a concentrate was its weight percent times the weight of the concentrate.

The estimated tenor of a cubic yard of flood plain sediment in this reconnaissance appraisal was the weight of the mineral in the concentrate multiplied by appropriate factors for the original volume of the sample corrected for swell. No corrections were made for losses in panning.

The volume and tenor of the alluvium, and the resources in monazite in the 44 drainage basins outlined in Fig. 1, are estimated in Tables IA through ID. Numbers assigned to the drainage in Tables IA through ID match the numbers in Fig. 1. Columns headed "Estimated Volume of Sediment Explored" contain sums of the volumes of the separate classes of sediment estimated to be in the individual flood plain in each basin. The columns headed "Estimated Resources in Monazite" contain the sums of the weights of monazite estimated to be in each class of sediment in the individual flood plains in each basin. Columns headed "Tenor" were compiled by dividing the volume of sediment into the resources in monazite. No check is available for these tenors, but checks are available for the average tenor in monazite of several individual flood plains appraised by the Survey and subsequently drilled by the USBM (Table II). These comparisons suggest that the tenors listed in Table I are of the proper order of magnitude.

The resources in monazite shown in Tables IA through ID are summarized in Table III, which gives an estimate of the resources in zircon.

Thorium and Uranium: The resources in thorium and uranium in the alluvial monazite deposits listed in Tables IA through ID amount to 40,000 short tons of thorium and 3700 short tons of uranium (Table IV). The small contribution to these resources made by the hundreds of thousands of tons of zircon in the deposits shows that this mineral is not a source for thorium and uranium in this area.

Small deposits at the extreme heads of the creeks, some of which were the former sites of monazite mining in the Piedmont, are not included in the estimates of resources given in the tables. Despite their small size the vast number of these deposits, combined with high average tenor, reported by Mertie³ to be 8.4 lb of monazite per cu yd and observed by the writers to be about 4 lb of monazite per cu yd of sediment, provide substantial resources of thorium and uranium. In the area covered by Fig. 1 the small deposits are estimated to contain 250,-

000 short tons of monazite. On the average this monazite contains 5.4 pct ThO₂ and 0.44 pct U₃O₈. Thus these small deposits contain an estimated 13,000 short tons of thorium and 1100 short tons of uranium.

Conclusions: The resources of thorium and uranium in deposits of alluvial monazite in the western Piedmont of North and South Carolina between the Savannah and Catawba rivers are estimated to be 53,000 tons of thorium and 4600 tons of uranium in more than 2 billion cu yd of material. None of these deposits are mineable at 1958 prices.

The work leading to this report was sponsored by the Division of Raw Materials of the U. S. Atomic Energy Commission and was conducted by the U. S. Geological Survey between July 1951 and June 1954. The choice of area examined and many ideas related to methods were influenced by previous investigations made by J. B. Mertie, Jr.³ in North and South Carolina, Georgia, Alabama, and Virginia. A. M. White, N. P. Cuppels, and D. W. Caldwell of the USGS did much of the field work upon which this report is based, and J. Stone supervised the mineralogical examination of the samples collected by the field party. R. F. Griffith and L. A. Hansen of the U. S. Bureau of Mines directed the drilling of 12 deposits in the area.⁹⁻¹³

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Discussion of this article sent (2 copies) to AIME before Aug. 31, 1959, will be published in MINING ENGINEERING.

Two growing problems confront the preparation engineer—still further restrictions on stream pollution and a greater proportion of fine coal as more and more continuous miners come into use. The dewatering screens, centrifuges, and settling ponds that sufficed a few years ago must often be supplemented by more effective equipment, and in some instances the finest solids are now being recovered by vacuum filtration, once considered too costly in many coal washeries. Unfortunately not all slurries can be readily filtered. Some are virtually unfilterable, and others do not permit the high cake rates needed to hold costs within reason. Often, however, these difficult slurries can be rendered filterable by flocculation.

Starch and lime have long increased settling rate in thickeners and can also aid filtration. More recently there have been other flocculants, primarily synthetic polymers or gums. Reports of their great effectiveness prompted the U. S. Bureau of Mines to test their use in filtration as part of its program on recovering and cleaning fine coal. The object of the present work was to compare some of the newer flocculants with starch and lime and to test the reaction of different types of slurries to flocculation. Three natural slurries, three synthetic coal-clay mixtures, and five flocculants were tested, all with a laboratory filter leaf.

Slurries and Flocculants Tested: First of the slurries was the thickener feed from the washed coal section of the Michel colliery of Crow's Nest Pass Co. Ltd., Michel, B.C.

As shown by the screen and ash analyses in Table I, practically all this slurry was finer than 28 mesh, and about half the solids were finer than 200. Substantially all material coarser than 200 mesh was clean coal, but the ash content of 20.7 pct in the finest size indicates a moderate amount of impurity. This coal is medium-volatile bituminous in rank.

Slurry was also obtained from the Black Diamond washery of Palmer Coking Coal Co., King County, Wash. This underflow of a $\frac{1}{2}$ -mm vibrating slurry screen is a waste product discharged to a settling pond. As shown by the data in Table I it contained about 20 pct material finer than 200 mesh, which analyzed 77.5 pct ash, indicating a high proportion of clay. The coarser sizes were also high in ash content because of the presence of bone and shale. Black Diamond coal is on the dividing line between bituminous and subbituminous rank.

The third slurry, from the washery of Roslyn-Cascade Coal Co. in Kittitas County, Wash., was the underflow of a battery of 8-in. cyclones that is wasted with the coarser refuse from the plant. In both size and ash content this slurry was similar to the Black Diamond, but since it was a cyclone-underflow product, the fraction finer than 200 mesh undoubtedly contained a much smaller proportion of finely divided clay than was present in the Black Diamond slurry. The Roslyn-Cascade coal is high-volatile A bituminous in rank.

Initially the slurry samples were stored in the laboratory at a concentration of 40 pct solids. A progressive change in filtration and flocculation

LABORATORY INVESTIGATION —

FLOCCULATION TO IMPROVE COAL SLURRY FILTRATION

by M. R. GEER, P. S. JACOBSEN, and H. F. YANCEY

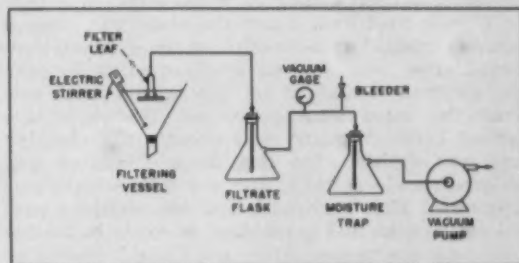


Fig. 1—Test leaf filtration apparatus.

characteristics during storage was noted, however, presumably because of progressive disintegration of the clay. After careful testing demonstrated that the slurry solids could be dried and then repulped without changing the original filtration characteristics, this procedure was adopted.

The flocculants used were Separan 2610, Kylo 27, Jaguar MD-A, Idaho potato starch, and lime. The lime was used as a slurry, the Separan 2610 as a 0.10 pct aqueous solution, and the other flocculants as 0.50 pct aqueous solutions. The starch was causticized with sodium hydroxide before use. As some of the flocculants are reported to deteriorate on storage, new batches of flocculants were prepared every two days.

Test Procedure: Fig. 1 diagrams the filter leaf apparatus employed. This consists of a test leaf having an effective area of 0.10 sq ft., a 60°, 8½-in. diam cone to hold the slurry sample, a variable-speed electric stirrer, vacuum gage, bleed line for controlling vacuum, filtrate flask, moisture trap, and vacuum pump.

Two filter cloths were selected—Saran SA 603, a monofilament, coarse-weave cloth, and polyethylene PO-801 HF, a monofilament, fine-weave cloth. The Saran was selected to provide maximum cake rate without regard to clarity of filtrate and the polyethylene to provide the best quality of filtrate without regard to cake rate.

The test charge for the filtering vessel consisted of 800 g of solids (previously soaked for 24 hr) and

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Table I. Size and Ash Content of Slurry Solids

Slurry	Over 25	25 to 45	45 to 100	100 to 200	Under 200	Total
Crow's Nest Pass						
Screen analysis, pct	1.3	3.5	20.7	25.5	49.0	100.0
Ash, pct	12.2	8.2	8.9	11.3	20.7	15.3
Black Diamond						
Screen analysis, pct	6.3	25.8	31.7	16.3	19.9	100.0
Ash, pct	15.9	18.9	31.1	53.6	77.5	39.9
Roslyn-Cascade						
Screen analysis, pct	8.7	17.4	31.8	18.4	23.7	100.0
Ash, pct	19.3	29.5	36.8	43.3	73.1	43.8

1200 g of water, giving a standard solids concentration of 40 pct. The desired amount of flocculant was added and the mixture stirred for 2 min. The vacuum was then turned on and the test leaf immersed in the funnel so that the leaf face was just covered. As filtration commenced, the vacuum was adjusted and maintained at 25 in. of mercury. The filtration cycle consisted of 0.80 min form time followed by 1.10 min drying.

The two filter runs made are designated trials 1 and 2. Trial 2 was obtained by returning the cake and filtrate of trial 1 to the funnel, remixing, and refiltering without adding more flocculant. In tests of the Crow's Nest Pass slurry the cloth was cleaned between trials, but with other slurries it was not. Comparative tests showed that reduction in cake rate generally obtained on the second trial was much the same whether or not the cloth was cleaned between trials; consequently the cleaning step was omitted for the Black Diamond and Roslyn-Cascade slurries. The wet cake weight was determined after each trial, and the moisture content of the cake and percentage of solids in the filtrate was determined after the second trial. The purpose of the second trial was to provide a measure of floc strength, that is, to evaluate the extent of floc destruction caused by remixing.

With a readily filterable slurry, one giving a dry cake rate exceeding 165 lb per sq ft, the entire usable volume of slurry in the vessel was exhausted in less than the standard 0.80 min form time; also, the standard vacuum could not be attained. With such slurries an adaptation of a formula advanced by Silverblatt and Dahlstrom⁷ was used to convert the data to the same basis as that for less filterable slurries. The equation is as follows:

$$R = 5720 (TV)^{-1/2} \quad [1]$$

where R = dry filter rate, lb per hr per sq ft
 T = time required to filter charge, sec
 V = vacuum attained during time T , in. of Hg.

The cake rates obtained with this test procedure probably cannot be translated directly into rates for a commercial filter, but they provide useful comparative values for judging the effectiveness of flocculation.

Results of Filtration Tests: Results obtained with the test leaf are presented in Tables II through V, in terms of cake rate, moisture in cake, and percentage of solids in filtrate.

In untreated form the Crow's Nest Pass slurry gave cake rates of 50 and 68 lb per hr per sq ft, respectively, with the fine and coarse cloths, which classes it as being filterable but providing only a moderate cake rate. Separan, Kylo, and Jaguar all behaved quite similarly with this slurry. All three

increased the cake rate three to fourfold, were nearly as effective with the minimum flocculant concentration of 0.025 lb per ton as with the maximum, provided nearly as high cake rates with the fine cloth as with the coarse, and showed little reduction in cake rate between the first and second trials. All three flocculants slightly increased the moisture content of the cake obtained with the fine cloth, but no more than would be expected with the increased thickness of cake. All three reduced the percentage of solids in the filtrate to about the same level—0.04 to 0.07 with the fine cloth and 0.59 to 1.67 with the coarse cloth. The figures representing quality of filtrate are the only data showing any influence of increasing flocculant concentration. With all three flocculants each increase in concentration distinctly improved the quality of filtrate obtained with the coarse cloth.

The amount of Crow's Nest Pass slurry available did not permit testing lime and starch at the low concentrations employed for the other flocculants; they were used at concentrations from 0.10 to 4.0 lb per ton, as shown in Table V. Lime was not a particularly effective reagent with this slurry. Even when used at 4 lb per ton it increased the cake rate only twofold. Starch, on the other hand, when used at 0.4 lb per ton, provided cake rates fully as great as those obtained with the newer flocculants, and equaled these flocculants in terms of cake moisture and filtration quality.

In natural form the Black Diamond slurry could not be filtered with either the coarse or fine cloth. Cake rates exceeding 11 lb per hr per sq ft could not be obtained, the cakes analyzed up to 50 pct moisture, and the filtrates were dirty. But the same concentrations of flocculant used with the Crow's Nest Pass slurry strikingly improved filtration. Separan, Kylo, and Jaguar all were effective. Separan gave the highest cake rates obtained—390 lb. These flocculants reduced the solids in the filtrate to 0.05 pct with the fine cloth and 0.18 to 0.49 pct with the coarse cloth, as well as cutting cake moisture content in half. Lime was ineffective at the concentration shown in the tables and even when used at 4.5 lb per ton was distinctly inferior to the other flocculants. At 0.025 lb per ton starch was a fairly good flocculant, and when employed at 1 lb per ton it gave cake rates exceeding those obtained with all the flocculants except Separan. With this slurry the cake rates obtained with the coarse cloth were only moderately higher than those provided by the fine cloth, and the coarse cloth provided filtrate of better quality than was obtained with either of the other two slurries.

In raw form the Roslyn-Cascade slurry could not be filtered at all with the fine cloth but gave cake rates of 119 to 89 lb per hr per sq ft with the coarse cloth. Because of the high cake rate obtained with the coarse cloth the concentration of flocculant used with this slurry was reduced to a range of 0.00625 to 0.025 lb per ton. At 0.00625 lb per ton, however, there was virtually no improvement in filtration with the fine cloth and only a moderate increase in cake rate with the coarse cloth. Increasing the dosage improved the results obtained with Separan, Kylo and Jaguar, Separan providing the highest rate. The fact that each increase in flocculant concentration substantially increased the cake rate for these reagents suggests that the optimum level of concentration was not obtained, even at the maximum dosage.

Table II. Cake Rates Obtained With Various Flocculants

Slurry	Flocculant*	Cake Rate, Lb Per Hr Per Sq Ft, Dry							
		Fine Filter Medium				Coarse Filter Medium			
		0	0.025	0.05	0.10	0	0.025	0.05	0.10
Crow's Nest Pass**	None								
	Trial 1	50	—	—	—	67	—	—	—
	Trial 2	50	—	—	—	68	—	—	—
	Separan 2610								
	Trial 1	—	143	181	210	—	170	243	247
	Trial 2	—	140	168	197	—	140	207	218
	Kylo 27								
	Trial 1	—	139	149	158	—	149	190	198
	Trial 2	—	150	156	162	—	130	174	198
	Jaguar MD-A								
	Trial 1	—	134	183	203	—	157	181	218
	Trial 2	—	119	147	169	—	142	132	204
Black Diamond	None								
	Trial 1	4	—	—	—	11	—	—	—
	Trial 2	1	—	—	—	6	—	—	—
	Separan 2610								
	Trial 1	—	322	390	467	—	322	425	491
	Trial 2	—	56	205	390	—	210	343	390
	Kylo 27								
	Trial 1	—	156	216	244	—	220	322	390
	Trial 2	—	26	149	167	—	175	250	277
	Jaguar MD-A								
	Trial 1	—	229	306	343	—	265	322	365
	Trial 2	—	125	216	256	—	199	277	343
	Starch								
	Trial 1	—	3	66	167	—	42	123	229
	Trial 2	—	2	3	25	—	20	37	127
	Lime								
	Trial 1	—	4	4	4	—	11	11	11
	Trial 2	—	1	1	1	—	6	6	6
Roslyn-Cascade	Flocculant*	0	0.00625	0.0125	0.025	0	0.00625	0.0125	0.025
	None								
	Trial 1	1	—	—	—	119	—	—	—
	Trial 2	1	—	—	—	80	—	—	—
	Separan 2610								
	Trial 1	—	4	116	343	—	164	390	491
	Trial 2	—	1	5	188	—	146	169	365
	Kylo 27								
	Trial 1	—	5	98	145	—	203	234	256
	Trial 2	—	5	103	145	—	203	239	292
	Jaguar MD-A								
	Trial 1	—	4	24	256	—	156	224	390
	Trial 2	—	1	1	177	—	105	186	322
	Starch								
	Trial 1	—	1	2	2	—	145	159	229
	Trial 2	—	1	1	1	—	109	101	93
	Lime								
	Trial 1	—	1	1	1	—	119	121	120
	Trial 2	—	1	1	1	—	80	91	93

* Pound per ton of solids.

** See Table V for lime and starch results.

Table III. Moisture Content of Cakes Obtained With Various Flocculants

Slurry	Flocculant*	Moisture in Cake, Pct							
		Fine Filter Medium				Coarse Filter Medium			
		0	0.025	0.05	0.10	0	0.025	0.05	0.10
Crow's Nest Pass**	None	22.4	—	—	—	27.7	—	—	—
	Separan 2610	—	24.6	25.3	26.1	—	28.5	30.5	30.6
	Kylo 27	—	24.8	25.3	25.2	—	26.9	28.4	28.2
	Jaguar MD-A	—	23.9	25.1	24.5	—	26.1	26.7	26.4
Black Diamond	None	50.0	—	—	—	42.0	—	—	—
	Separan 2610	—	23.4	22.7	23.2	—	23.5	23.8	24.8
	Kylo 27	—	24.5	25.0	24.6	—	24.1	25.4	24.1
	Jaguar MD-A	—	23.5	24.3	21.0	—	24.1	24.3	24.3
	Starch	—	50.0	39.6	21.4	—	29.6	22.3	23.3
	Lime	—	50.0	50.0	80.0	—	42.0	42.0	42.0
Roslyn-Cascade	Flocculant*	0	0.00625	0.0125	0.025	0	0.00625	0.0125	0.025
	None	40.0	—	—	—	23.0	—	—	—
	Separan 2610	—	40.0	21.7	21.3	—	21.1	19.8	19.5
	Kylo 27	—	27.8	20.4	20.4	—	21.8	20.5	20.9
	Jaguar MD-A	—	32.6	35.0	19.9	—	22.5	21.2	20.6
	Starch	—	40.0	40.0	40.0	—	22.0	22.0	20.9
	Lime	—	40.0	40.0	40.0	—	23.9	23.6	23.6

* Pound per ton of solids.

** See Table V for lime and starch results.

Table IV. Solids in Filtrate Obtained With Various Flocculants

Slurry	Flocculant*	Solids in Filtrate, Pct							
		Fine Filter Medium				Coarse Filter Medium			
		0	0.025	0.05	0.10	0	0.025	0.05	0.10
Crow's Nest Pass**	None	0.18	—	—	—	4.00	—	—	—
	Separan 2610	—	0.07	0.05	0.04	—	1.33	0.81	0.59
	Kylo 27	—	0.06	0.06	0.06	—	1.40	1.18	0.98
	Jaguar MD-A	—	0.07	0.05	0.04	—	1.67	1.33	0.92
Black Diamond	None	0.24	—	—	—	2.44	—	—	—
	Separan 2610	—	0.06	0.05	0.05	—	0.33	0.27	0.18
	Kylo 27	—	0.06	0.05	0.05	—	0.39	0.45	0.41
	Jaguar MD-A	—	0.06	0.05	0.05	—	0.49	0.47	0.23
	Starch	—	0.11	0.08	0.08	—	1.90	1.40	0.69
	Starch	—	0.11	0.08	0.08	—	1.90	1.40	0.69
	Lime	—	0.34	0.24	0.24	—	2.44	2.40	2.40
Roslyn-Cascade	Flocculant*	0	0.00025	0.0125	0.025	0	0.00025	0.0125	0.025
	None	0.49	—	—	—	1.59	—	—	—
	Separan 2610	—	0.21	0.10	0.06	—	0.93	0.75	0.65
	Kylo 27	—	0.11	0.08	0.06	—	0.73	0.65	0.58
	Jaguar MD-A	—	0.49	0.12	0.07	—	1.28	0.79	0.51
	Starch	—	0.49	0.22	0.14	—	1.13	1.08	0.95
	Starch	—	0.49	0.22	0.14	—	1.13	1.08	0.95
	Lime	—	0.49	0.41	0.34	—	1.59	1.50	1.51

* Pound per ton of solids.

** See Table V for lime and starch results.

Table V. Filtration Data of Crow's Nest Pass Slurry Flocculated with Lime and Starch

Flocculant*	Fine Filter Medium						Coarse Filter Medium					
	0.10	0.20	0.40	1.0	2.0	4.0	0.10	0.20	0.40	1.0	2.0	4.0
Lime												
Cake rate, lb per hr per sq ft, dry												
Trial 1	—	—	—	82	105	110	—	—	—	75	103	114
Trial 2	—	—	—	69	90	90	—	—	—	69	99	93
Moisture in cake, pct	—	—	—	21.6	22.5	22.5	—	—	—	25.8	25.5	24.6
Solids in filtrate, pct	—	—	—	0.11	0.07	0.08	—	—	—	4.29	2.69	2.54
Starch												
Cake rate, lb per hr per sq ft, dry												
Trial 1	125	168	197	—	—	—	130	207	251	—	—	—
Trial 2	122	157	155	—	—	—	134	146	202	—	—	—
Moisture in cake, pct	25.3	24.4	24.2	—	—	—	28.2	24.9	26.2	—	—	—
Solids in filtrate, pct	0.08	0.05	0.04	—	—	—	1.55	1.21	0.97	—	—	—

* Pound per ton of solids.

Table VI. Cake Rates Obtained From a Synthetic Slurry Contaminated With Various Clays

Flocculant*	Filter Rate, Lb Per Hr Per Sq Ft, Dry											
	Kaolinite				Calcium Montmorillonite				Sodium Montmorillonite			
	0.00	0.025	0.05	0.10	0.00	0.025	0.05	0.10	0.00	0.025	0.05	0.10
None												
Trial 1	51	—	—	—	48	—	—	—	50	—	—	—
Trial 2	51	—	—	—	44	—	—	—	40	—	—	—
Jaguar MD-A												
Trial 1	—	60	60	64	—	60	136	160	—	99	125	210
Trial 2	—	58	59	61	—	49	105	156	—	82	105	163
Kylo 27												
Trial 1	—	123	139	189	—	110	144	165	—	179	196	249
Trial 2	—	107	155	170	—	95	138	155	—	174	179	237
Separan 2610												
Trial 1	—	55	60	177	—	58	95	177	—	170	229	234
Trial 2	—	54	54	154	—	52	77	166	—	154	191	215
Flocculant*	0.00	0.750	1.50	2.0	0.00	0.750	1.50	2.0	0.00	0.750	1.50	2.0
Lime												
Trial 1	—	69	107	113	—	57	78	120	—	155	196	218
Trial 2	—	59	83	102	—	50	53	99	—	144	167	206
Flocculant*	0.00	0.0750	0.150	0.30	0.00	0.0750	0.150	0.30	0.00	0.0750	0.150	0.30
Starch												
Trial 1	—	51	64	82	—	96	138	157	—	159	192	278
Trial 2	—	51	52	63	—	56	97	118	—	95	135	257

* Pounds per ton of dry solids.

With this slurry the influence of floc strength is evident. At a concentration of 0.0125 lb per ton the first trial with Separan gave a rate of 116 lb, but in the second trial the rate fell to 5 lb, indicating that the flocs were too weak to withstand agitation of slurry between runs. On the other hand, Kylo gave substantially the same results in the first and second trials, indicating a much stronger floc.

With all flocculants, as with the raw slurry, much higher cake rates were obtained with coarse cloth than with fine, but the increase was accompanied by deterioration in the quality of filtrate, as revealed in Table IV.

At the concentration shown in Table II, neither lime nor starch provided any improved filtration with the fine cloth, but the maximum concentration of starch nearly doubled the initial cake rate obtained with the coarse cloth. However, the starch flocs were very weak, and cake rate on the second trial was not significantly improved over that for the raw slurry. At still higher concentration of flocculant the results obtained with lime were improved but never equaled those for Separan, Kylo, or Jaguar. In contrast, starch at 0.2 lb per ton provided cake rates of 368 to 285 lb with the fine cloth and 495 to 451 lb with the coarse. At this higher concentration, therefore, the cake rates with starch were higher than those obtained with Separan at the lower dosage in which it was used.

Experiments with Synthetic Slurries: Filterability of a slurry is related to the amount and nature of extreme fines present.¹ Clay generally impedes filtration, and since individual types of clay often behave quite differently, the influence of clay on filtration and flocculation was investigated. A synthetic slurry matching the size composition of the Black Diamond slurry shown in Table I was prepared by grinding a clean bituminous coal from Utah to required fineness. This slurry gave a cake rate of 391 lb per hr per sq ft with the coarse cloth. Then admixtures of three different clays were made. One clay was a bentonite containing principally sodium montmorillonite, the second a bentonite in which the predominant clay mineral was calcium montmorillonite, and the third a kaolinitic clay. The first step was to determine how much of each clay was required to reduce the test-leaf filtration rate to an arbitrary level of 50 lb. The following percentages were required: sodium montmorillonite, 0.8 pct; calcium montmorillonite, 7.5 pct; and kaolinite, 16.2 pct. Thus it is evident that the type of clay contaminating a slurry has a major bearing on filtration properties.

Discussion

J. G. John (Preparation Engineer, Crow's Nest Pass Coal Co. Ltd., Michel, B.C.)—This excellent paper by Geer, Jacobsen, and Yancey was particularly interesting to our company, as we have just placed in operation a slimes recovery plant at our Michel colliery. The slurry recovered, by means of flocculation, thickening, and filtration, is one of the three natural slurries used in the described investigation.

From Tables II and IV of the paper it is noted that rate of cake formation and filtrate clarity improve with increase in flocculant concentration. In our operation the flocculant concentration is primarily controlled by the settling character of our slurry in the thickener rather than by filterability of the thickener underflow going to the filter.

Samples of the synthetic slurry contaminated with the amounts of individual clays required to reduce cake rate to 50 lb were flocculated and filtered according to the same test procedures employed for the natural slurries previously described, except that only the coarse filter cloth was used. Results of these tests are shown in Table VI.

With the kaolinite-contaminated slurry neither Jaguar nor starch was effective. Kylo was the best flocculant, followed closely by Separan. Lime, which had proved ineffective with the three natural slurries, was better than smaller amounts of either starch or Jaguar.

With the slurry containing calcium montmorillonite Jaguar, Kylo, and Separan were about equally effective, and starch at a concentration of 0.3 lb per ton was nearly as effective as the three better flocculants at 0.10 lb. With the slurry containing sodium montmorillonite clay all five flocculants were about equally effective when used at their maximum concentration, each of them increasing the cake rate four or fivefold.

Conclusions: Experimental results appear to support two principal conclusions: First, three natural and three synthetic slurries tested exhibited individual filtration characteristics and individual flocculation properties; moreover, their behavior was not related directly either to size composition or to ash content. Thus each slurry must be evaluated individually for possible benefits of flocculation to be predicted. Substantially the same conclusion was reached by Meerman,² whose investigation was on a full plant scale.

Second, some of the newer flocculants are so effective that only a few thousandths of a pound per ton are needed, but with the slurries examined the performance obtained did not exceed that possible with greater amounts of starch.

The work described in this report is part of a continuous program of coal preparation research sponsored jointly by the Northwest Experiment Station of the U. S. Bureau of Mines and the School of Mineral Engineering of the University of Washington.

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Discussion of this article sent (2 copies) to AIME before Aug. 31, 1959, will be published in MINING ENGINEERING.

With our particular slurry we found it advantageous to use a dry synthetic starch manufactured in England. Flocculant concentration required is 30 ppm of slurry or 0.3 lb per ton of dry coal recovered. The concentration is considerably greater than those concentrations used in the described investigation, namely 0.025 to 0.10 lb per ton.

With concentrations in excess of 60 ppm we noted a deterioration in the settling rate characteristics.

It is our experience, too, that flocculation requirements of a slurry cannot be solely predetermined from consideration of the coal slurry's sizing and ash content. The advent of the new synthetic flocculants gives the coal preparation personnel additional opportunity in this lucrative field of coal recovery.

ADVANCING THROUGH CAVED GROUND WITH YIELDABLE ARCHES

by JAMES QUIGLEY

As the outcrop mines in the West developed into underground operations, systems of ground support were gradually evolved. In the early coal mines there was little need for support except near the dirt line in portals, where stone masonry was common. Where the top was shaley or broken, native pine props with light cross bars and legs furnished enough support even in Utah's 25-ft coal seams. As depth of workings increased, roofs and backs of the same general nature as those near the surface became more and more unstable and required more and more support. Some coal airways show this tendency very clearly. From the surface down the same type of roof shows deterioration which an experienced eye can translate into a measure of depth under surface rather than change in rock characteristics.

Rock bolts, developed by various companies and by the U. S. Bureau of Mines, have become an effective substitute for timber in sections of some metal and nonmetal mines formerly requiring excessive timber support, and further use of war surplus landing mats, chain link fencing, and a new punched channel developed by one of the steel companies has enabled other mines to operate deposits where costs of timber and lack of clearance for timber support would have prohibited mining. The block caving mines have made extensive use of reinforced concrete underground to achieve similar ends under difficult conditions. Steel sets are standard in many Bureau of Reclamation projects, although these are usually covered in with concrete to make the permanent structures the Bureau's reclamation projects require. But the use of steel in mining operations is limited and has been confined principally to the iron ore mines of Michigan, Wisconsin, and Minnesota. Some mines have installed used rail as posts, caps, and crossbars, but a rail section is not suited for load carrying, and used rails are generally brittle, having a tendency to fail without warning when overloaded.

European mines were the first to reach the size of worked out areas and depths of cover resulting in major roof problems. The Europeans resorted to pack walls and masonry walls, in conjunction with timber arched sets, rail arches, and combination timber and rail and steel arches. The give in these pack walls and wooden blocking was supplemented by a hinge in the center of the arch. This design is called an *articulated arch*. Through various refinements of this principle of the support giving gradually with the load, Toussaint-Heintzmann developed

the *yielding* or *sliding* arches, in which yield is accomplished by friction in the overlapping joints of the arch. This type has gained widespread acceptance in the Ruhr and Lorraine Basin and is being manufactured by Bethlehem Steel for sale in this country. In North America the anthracite mines in Pennsylvania, followed by certain iron ore mines in upper Michigan and Canada, were the first to employ these arches to any extent. The practice was later adopted by Kennecott at Ruth, Nev., and by others. Despite high initial cost, the use of these arches is growing in many parts of the country because of their suitability in heavy ground.

In its present form of manufacture the yieldable arch consists of open U-shaped rolled section with heavy beads on the edge. The open edge of the U is placed toward the wall. The section nests in another section of the same dimensions, and an arch can be built up from rolled radii and tangents of various weights and lengths. Sections are fastened together by U bolts and saddles. The lap on the joint varies from 12 to 24 in., and ordinarily the bolts are tightened with a 1-in. drive air wrench. The arches are spaced with channel struts held by J bolts and saddles. Sections can also be obtained that are composed of various combinations of radii and tangents and true circles. The joints can be placed to bear against anticipated loads and asymmetrical loads imposed by dipping strata. In the arches now being manufactured clearance widths up to 19 ft are obtainable in weights of sections from 9 to 30 lb per ft. The circular cross sections are available in the same weights ranging from 8 to 16 ft diam. At present most of the arches sold are supplied only in carload lots. It is hoped that demand will grow so that distributors can stock various weights and sections to give small operators a chance to try this new type of rock support under their own particular conditions.

Several excellent papers have discussed the properties of various sections now manufactured, the dimensions of the sets obtainable, and their application under widely differing conditions. The present article will describe the methods and results of a special use of the arches at Kaiser Steel mine No. 3, Sunnyside, Utah.

Problem at Mine No. 3: In 1953 Kaiser Steel Corp. laid out Sunnyside mine No. 3 to recover coking coal left by the previous operator, Utah Fuel Co., below workings that had been abandoned in 1928. Two seams had been worked, the upper and lower, separated by 30 to 42 ft of rock. Approximately 10 million tons of coal had been extracted from this area some 3000 ft down the pitch from the outcrop to a 1500-ft depth of cover. The mine had been opened by slopes in both upper and lower seams. Sometime in the late 1920's the lower slope

J. QUIGLEY, Member AIME, is Vice President, Centennial Development Co., Eureka, Utah. TP 4812F. Manuscript, Oct. 3, 1958. Rocky Mountain Minerals Conference, Salt Lake City, September 1958. AIME Trans., Vol. 214, 1959.

caved about 3000 ft from the portal. Utah Fuel cleaned up this cave and retimbered the slope, but weight induced by depth of cover and by mined out areas on the sides of the slope rapidly crushed this timber and enlarged the original cave. After one more attempt at reopening, using timber which again failed, the mine was abandoned and allowed to fill with water.

Concrete the First Solution Attempted: Because it was necessary to integrate this mine with the surface plant serving all three mines, Kaiser reopened No. 3 through the old caved slope. The upper portion was regraded to a pitch from 10 pct at the top to 7 pct near the cave. Pumps were installed at the cave to handle water, and rock bolts and landing mats held the walls and roof while the walls were lined with 12-in. concrete, reinforced with 1½-in. bars on 12-in. centers. The caved material was gobbled over the top of this concrete as mining advanced. This cave was found to be up to 25 ft wide and 55 ft high, breaking into and above the upper seam in places.

Shortly after this work was completed, while drop-ins were being prepared for mining entries below the cave, evidence of tremendous weight became apparent. In old entries and slopes adjacent to the main slope the same intense pressure developed, making it impossible to hold the drop-ins with normal timber, bolting, and landing mat and rib support. Although entries above the cave continued to produce coal, it was impossible to commence mining in the entries below. Roofs and ribs deteriorated rapidly, and six months after the major project of cleaning up and concreting on the main slope was completed, the necessary drop-ins and air courses became a problem more serious than the original cave that had forced abandonment in the 1920's. Cracks developed in the concrete walls, opening up as much as 4 in., and the lower portion of the walls pushed in as much as 5 in. Eventually the concrete cracking reached a limit and the ground appeared to be stabilized, but the loads seemed to shift to the adjacent openings needed for haulage and ventilation. It seemed inevitable that this pressure would increase as the entries above the cave were worked out, throwing more and more load on the slope pillars and on the virgin ground below.

Since concrete support had proved inadequate, the Kaiser management reverted to the possibility of using steel arches, originally considered for the clean-up job in the cave. When a bolted aircourse parallel to the main slope showed signs of failure it was buttressed by 15 ft-per-lb section yieldable arches. These arches, 16 ft wide at the base and 9 ft high in the center, were first placed on 4-ft centers and later on 2-ft centers.

Following a severe bounce in the Kaiser No. 1 mine in January 1957, other arches were installed on 2-ft centers in the main slope through a heavy area near a major fault that was believed to be the axis of loads related to tectonic movement. The early arches were placed by cleaning up the rock and standing an arch, then cribbing with 6x8 timber to the roof as in an ordinary timber set. The original arches paralleling the concrete-lined cave have stood up under heavy loads, some joints yielding as much as 8 in., but timber cribbing is slow and hazardous and difficult to block to achieve an even load distribution. Some of the loads seemed to

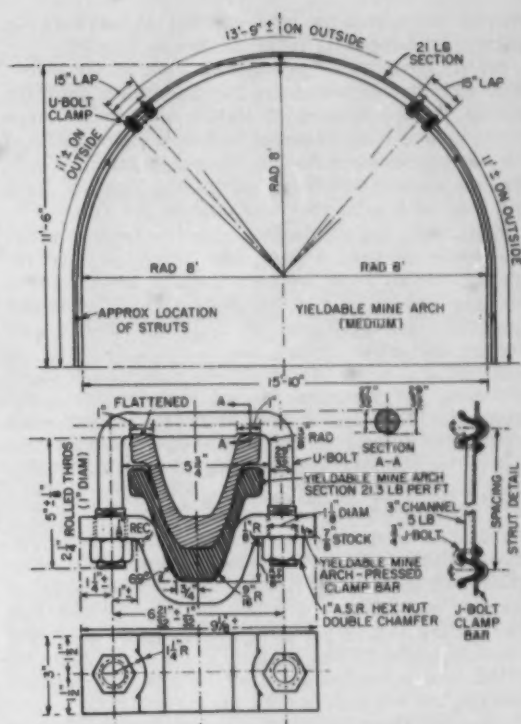


Fig. 1—Arch used at Kaiser Steel Mines, Sunnyside, Utah.

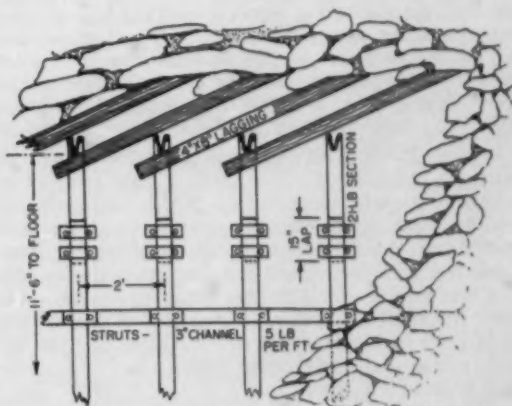


Fig. 2—Plank spilling driven over standard arches.

be horizontal and might be movement related to the mined out areas on either side of the supported areas, and some of the load evidently resulted from the dead weight of the crushed rock mass lying above the arch. A third source of load impingement comes from pillars in the mined out upper seam bearing directly on the roof of the lower seam 30 ft below.

Resort to Spilling: To provide additional coking coal for Kaiser's Fourth Blast Furnace expansion program it was necessary to continue reopening mine No. 3 beyond the limits of the mining entries at the bottom of the concrete. The old development slopes driven by Utah Fuel were certain to be caved. Because the arches in the No. 1 mine slope and in the aircourse paralleling the concrete had

proved successful, is was decided to advance by spiling, or forepoling using arches as support.

As the caves to be penetrated were under water, their extent was unknown. In appearance they are tightly packed masses of slabby shale with some admixture of coal. The coal and rock in the walls of the old entries have flowed inward as much as 2 ft, leaving a face consisting of packed crushed rock and coal with solid rock and coal on the ribs.

Work with the yieldable arches has been in progress for more than a year, and it is clear that reopening caved areas by removing as little rock as possible results in a much more stable permanent opening. The problems of sealing between air courses and gobs, which necessitated cleaning up many of the crosscuts and then rebolting, can be overcome by pumping fill into the voids in the crosscuts. It is also obvious that the crushed rock around the spiling forms a protective cushion that distributes the load evenly, and although the arches have yielded up to 4 in. in some sections, there is very little distortion.

From an operating standpoint spiling is simple. The first two sets must be blocked accurately, after which 4x8 planks 6½ ft long, with a 6-in. taper on one end, are driven out under the rear set and over the leading set. When the planking on roof and sides has sealed off the loose rock, the caved material in the face is loaded out and the next set erected. Perhaps the ultimate would be to substitute a steel channel for the plank, but at present treated plank is the most economical.

Various systems of jacks and come-alongs have been used to raise the center sections of the arch, but the best method is also the easiest. A 3-in. pipe is laid sloping up to the caved face just under the end of the 4x8 spiling, the bottom end resting on the floor. The miners push the center section of the arch up the pipe, and one man holds it in place while the legs are bolted on with air wrenches.

In coal mining all openings must be driven in pairs for ventilation. This gives a four-man crew a chance to split their duties. While two men are loading rock from one entry with a loader and shuttle car, the other two can drive spiling, drill, or block the arch to the walls in the other places. All join together to stand the set when the spiling has been installed. The holes necessary to break the large slabs in the face and overhang on the ribs are shot, and the loading crew returns to remove the rock from under the spiling.

Many of the problems in advance in spiling are normal to any type of rock advance in any mining operation. Waste haulage and materials delivery are necessarily intermittent; transportation of waste rock over the mine haulage depends on haulage of the mineral being mined, and arches and spiling must be brought in during normal material supply train schedules to avoid breaks in production. As opposed to cleaning up and cribbing, the lesser amounts of rock to be removed and material needed for spiling are important benefits.

Best performances, including the pumping of 250 gpm of water, are six sets per day on 2-ft centers, carried out on a two-shift basis with four men and a foreman on each shift. Where ventilation clears smoke from the shots readily, normal progress is two sets per shift, or 4 ft. If ground conditions permit 3 or 4-ft spacing, the work of driving the spiling is correspondingly easier and the advance in

feet can be increased proportionately, but problems of removing the waste rock remain the same.

Few tools are required. Air wrenches are a great help in tightening the nuts, although spud wrenches are needed to line up the holes and place the nuts. In driving spiling various methods have been used. Where the ground is soft a sheeting driver is suspended by a chain from the third arch from the face and swung into position behind each plank. In many cases, however, the caved material is coarse and slabby, and it is possible to advance the spiling by poking the loose rock ahead with a bar and tapping the plank with a double jack.

Kaiser mine No. 3 may be a special instance of weight coming on after the opening has been made. Other mines may require more elaborate mechanisms for driving the spiling. In one case in the No. 3 mine the caved material was exceptionally heavy and the crushed rock ran around the spiling, filling the face and preventing the standing of the next arch. Here conventional breast boards were blocked against the leading arch and the advance was continued, although it was slowed to one set per shift on 2-ft centers.

As ground support problems increase, spiling over yieldable arches should have wide application in mines of all types. Where it is not economical to use maximum support throughout the length of haulageways and airways, it must be anticipated that caves will develop at unsuspected pressure points during the useful life of the opening. Spiling by means of yieldable arches offers a quick and economical method of reopening these workings. Any loading method can be used. Since the cross sectional area of the steel arch is small compared to timber, less hand digging is necessary along the rib, and there is less rock to load out. The plank drives well over the steel with little friction, the angle of driving spiling is less than over timber sets, giving more effective length to each plank, and the great strength of the arch compared to that of timber insures low maintenance costs against loads of all natures. Doubling up is easy compared with timbering and is accomplished with little loss of clearance. If it is necessary to seal off the sides of the opening for purposes of ventilation, low pressure grouting is effective.

Steel manufacturers continue to develop different sizes and sections of arches, and a variety of dimensions and shapes offer uniform, dependable support, easily installed and maintained.

The authors acknowledge the cooperation of the officials of Kaiser Steel Co.; J. Peperakis, manager of mines at Sunnyside; and J. Taylor, chief engineer.

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Discussion of this article sent (2 copies) to AIME before Aug. 31, 1959, will be published in MINING ENGINEERING.

PRECISION SURVEY FOR TUNNEL CONTROL

by DOUGLAS D. DONALD

(MINING ENGINEERING, page 977, September 1958, AIME Trans., vol. 214)

C. J. Barber (U. S. Smelting Refining & Mining Co., Salt Lake City)—In his paper Donald describes how New Jersey Zinc Co. made surveys for a connection between the Ivanhoe and Van Mater shafts at Austinville, Va. Except to say that the two faces had to meet "accurately" on line and grade, Donald does not indicate the required precision.

Assuming that there were 24 angles in the 1½-mile traverse and 15 in the one-mile traverse, it can be shown that if the average error in plumbing each shaft was $\pm 30''$ and the average error in measuring each traverse angle was $\pm 10''$, then the average error at the point of connection would have been about ± 1.9 ft normal to the line between the shafts. This calculation assumes that any errors in the triangulation would be negligible compared with the errors in the plumbings and traverses, and it also neglects taping errors. With no constant errors or blunders, the latter would be important only in lines normal to the line between the shafts.

To make the average error at the connection less than 1.9 ft would, therefore, require either reducing the error in the plumbings to less than $\pm 30''$, or that in the traverse angles to less than $\pm 10''$, or fewer stations, or a combination of these.

Referring briefly to the triangulation, because of the problem of fitting a new triangulation into older surveys of the district the orientation deserved some mention, even though the connection could have been made with an assumed bearing. It would be interesting to know how many triangles were required and what the average summation error was before making any adjustments and without considering the algebraic signs. Perhaps this is referred to indirectly in the statement that the maximum angular error distributed was $2''$.

Turning to the shaft plumbings, it would be helpful to know how many men were employed and how long each shaft was in use. Donald says that the surface positions of W-2 and W-3 were carefully surveyed from the collar position of W-1, without indicating how this was done. The length of the backsight would be particularly important.

There must have been some error in setting W-1 vertically below the stations in the headframes. How immovable were the headframes, especially the Van Mater, which appears higher than the Ivanhoe and subject to more vibration because of skip hoisting?

Donald does not say whether the plumbing wires had been previously restraightened to minimize spinning (otherwise they behave like weak helical springs). The use of light steel weights is most surprising because there seem to be excellent reasons for using heavier, nonmagnetic weights. Did the shafts contain no steel sets, pipes, power cables, etc., which might attract steel?

The plumbing method described by Donald was designed for deep shafts in South Africa but differed from the South African practice in two important respects. As described by Browne,⁶ in South Africa the line between the wires was made parallel to the long axis of the shaft, whereas in the Ivanhoe shaft the lines between the wires were diagonally across the shaft. The main reason given for the South African practice is to insure that the gravitational attraction between the

wires and the rock walls is the same on both wires, and therefore does not affect the bearing of the line between them. It seems probable, however, that the effect of air currents might be minimized in the South African procedure, and might be serious with the wires in the diagonal position at the Ivanhoe shaft.

In the South African case cited by Donald the wires were swinging freely (although the plumb bobs were sheltered from air currents) but in the Ivanhoe case they were dampened with the plumb bobs set in water. In the discussion of Browne's paper R. St. J. Rowland said:⁷

It has been the practice for a long time to damp the oscillations by immersing the bobs in oil or water. The time per oscillation is thus increased, thereby extending the time taken to complete the work. The longer the suspended wire the less there is to recommend the practice...

The theoretical time for one swing of a simple pendulum 1050 ft long is approximately 36 sec, which would be increased by dampening the plumb bob in water. Hence very few complete swings would be observed in the 5 min intervals used at the Ivanhoe shaft. In the two South African cases described by Browne, the length of plumb line in one shaft was 5425 ft, the calculated period of swing was 81.6 sec, the average actual period was 76.6 sec, and 94 complete swings were observed in 2 hr. In the other case the length of plumb line was 3116 ft, the calculated period of swing was 61.8 sec, the average period was 63.5 sec, and 86 complete swings were observed in 1 hr 31 min. Browne concluded that observations of more than 30 swings are not likely to result in sufficient gain in accuracy to be justified.

Returning to the Ivanhoe and Van Mater plumbings, an objection to the method used is that all four azimuths were taken from fixed points instead of swinging wires, and that each pair of observations would—barring blunders—check closely, and so perhaps give a false feeling of security. In fact, it seems that only two azimuths were obtained from one plumbing, and not four as stated by Donald. Nevertheless, the tying in of each pair of wires from both sides of the shaft has much to commend it.

Donald's description leaves the impression that if each shaft was plumbed only once, the engineers were fortunate indeed if the average error in the underground orientation was as little as $30''$. Because the survey was done over a period of three years, it seems likely that the plumbings were repeated, perhaps more than once.

The underground traverse angles were measured by conventional methods, but because the number of angles in the overlapping traverses was not given, the angular closure given by Donald does not indicate the accuracy with which this was done.

Donald's description of a method of taping lines of irregular length is welcome. The literature on taping is usually confined to lines of about one tape length, generally 100 ft. Such lines are rare in metal mining because the time, trouble, and cost of setting points at 100-ft distances underground are not warranted. (Nevertheless civil engineers may go to this expense

in tunneling projects.) Was the base line measured in 100-ft drafts?

Unfortunately Donald did not give a sketch or photograph of the device by which the two men did all the taping.

Because one of the permanent rails was directly under the survey stations, it would seem to have been easier to tape USGS style along the rail, and to correct for inclination, than to have leveled each tape length. Perhaps the track was brought to final line and grade after the connection.

If the triangulation base were, say, 1200 ft higher than the 1100 level, and if no correction were made for elevation, then the calculated underground distance between the shafts would be about 0.75 ft longer than the taped distance.

Donald says that the precision obtained was considerably in excess of the requirements, but gives neither the requirements nor the actual closing error. If each shaft were plumbed only once, the engineers appear to have been very fortunate in this outcome.

Methods of improving the accuracy of the survey might have included:

- 1) Using an etched glass theodolite of European design, which would have many advantages over an American mining transit.

- 2) Reading the outside angles at all triangulation, plumbing, and traverse stations, so as to close on 360°.

- 3) Using re-straightened wire and heavier, non-magnetic plumb bobs.

- 4) Repeating the plumbing with the wires parallel to the long axis of the shaft, or at least with the wires in different positions in the shaft. If air currents were a serious problem perhaps a simplification of the Roberts' method¹⁰ might have been tried.

Reading Donald's interesting paper raises another question. When will mine surveys be oriented cheaply and conveniently by gyroscopic, electronic, or similar devices?

Douglas D. Donald (author's reply)—In response to C. J. Barber's discussion of my paper, I regret to state that to my knowledge, no final closure of the survey was carried out. I understand that when the tunnel faces were within about 200 ft of each other a diamond drill hole was put through. This hole cut the other face within a foot of centerline, but 2 or 3 ft above dead center. The joy occasioned by this holing through turned to consternation, for as the face advanced on line and grade the drillhole wandered upward and eventually disappeared in the back. As the tunnel drive continued, the hole wandered back into the face so that by the time the last round was taken it was approximately in its proper position in the advancing face. For practical purposes, the tunnel closed perfectly on line, although between 1 and 2 ft off on grade.

The article neglected to mention that check angles were turned on the long straight reaches of the tunnel and the sights on these shots were occasionally greater than 1000 ft. The new triangulation net used as its initial coordinates the original coordinates of one of the old stations and assumed an original bearing from the station. As I recall, nine triangles were used and the average summation error would be about 1".

In establishing W-2 and W-3 from W-1 positions, it was arranged so that the backsight was a station in the triangulation net and its length was between 40 and 50 ft. Angles were turned at W-1 from the backsight to W-2 and to W-3. The internal angle W2-W1-W3 was also turned and these results were compared with results obtained by subtraction. All hoisting operations were suspended while W-1 in each headframe was occupied by a transit and while the point was being transferred to collar elevations. In fact, a platform was arranged for the engineer to stand on while turning angles from W-1 in the headframe so his moving around the transit would not in any way disturb the set-up.

The spinning effect Barber refers to was minimized by inserting several small fishing tackle swivels in the plumbing line at widely spaced intervals. We take exception to the old theory that a plumbing wire must have no splices in it. Kinks, of course should be cut out and the wire fastened together by means of interlocking small open loops on a small swivel. The rigidity of the wire was sufficient to prevent closure of these loops when the heavier plumb bob was attached. I feel that mass effect on plumbing lines is generally overrated, especially since the greatest effect would be on the plumb bob itself, and this is usually located in a shaft station where the rock has been excavated for quite a distance in all directions around the bob.

Theoretically the resultant of mass effect on the wires may be determined by the distance of the midpoint of the line between the wires from the center of gravity of the shaft section. Should the midpoint of this line coincide with the center of gravity, it becomes obvious that each wire would be displaced so as to affect only the distance between the wires, but not the azimuth. The distance between the center of gravity and the midpoint of lines W1-W2 and W1-W3 was only about 1 ft. Thus mass effect would have negligible effect on azimuth.

We felt that our plumb lines did not act as a simple pendulum because of the three or four splices and swivels that occurred in the wire at irregular intervals. This was fully proved first by actually plotting the wire observations to see if there was a constant trend of the mean point between pairs of observations and, second, by the mean position of the second set of reading, which corresponded almost precisely with the results of the first set. Maximum permissible limits were ½ of a scale division (0.017 in.) and usually the averages checked to 0.2 of a scale division or better.

It is granted that fundamentally two independent sets of azimuths were taken off underground. However, the accuracy of each set is increased by using two groups of observations to arrive at each set.

Barber is entirely correct about repeated plumbings. Since the Ivanhoe was not a production shaft, our methods were initially worked out in that shaft. The Ivanhoe shaft was plumbed twice before acceptable results were obtained. The first plumbing of the Van Mater shaft appeared to be satisfactory, but a fatal blunder was made in not transferring the control to enough points in the shaft station. Several days after doing the job, a development crew shot out most of the control, so the plumbing had to be repeated. Each time the plumbing was carried out on a weekend and was completed in less than 16 hr so as not to interfere with production. Five engineers and a couple of helpers usually worked on the job.

Taped traverse distances were usually 105 to 110 ft long, but by using our calibration curve, we could accurately tape any distance up to 200 ft. The base line was taped with a 100-ft standardized tape, so each draft was 100-ft long plus or minus a few tenths of a foot.

Concerning Barber's concluding suggestions, I concur wholeheartedly about the benefits of a 1" theodolite. I neglected to state in the paper that all angles were turned first to the right and then to the left, thus closing to 360° on the plate.

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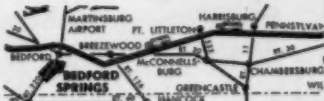
Reports of Your Technical Society



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The map pinpoints Bedford Springs, site of the September Coal-IndMD joint meeting. For technical program and reservation cards, see page 735. Flip the page for full-scale meeting data and news and views of the field trips planned.

PUBLISHING

is a major AIME function and this issue contains data on current and about-to-be published books of interest to SME members: *The Porphyry Coppers* in 1956, page 100 (Directory); new edition of *Industrial Minerals and Rocks*, page 734; and *Economics of the Mineral Industries*, page 101 (Directory).

The following preprints of interest to Coal men, are available from SME:

1958 Joint Solid Fuels

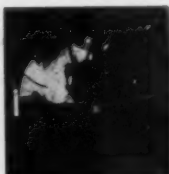
- SSSF1—Railroad Car Dumper Coal Sampling by W. R. Reichenstein and A. Bur.
- SSSF2—Fundamental Studies in Bulk Solid Flow by J. R. Lucas and W. J. Verner.
- SSSF3—A Petrographic Investigation of the Causes of Degradation of Sized Coal by R. C. Neavel.
- SSSF4—Dock Handling of Bulk Materials by R. C. Tench.
- SSSF5—Low Coke Button Bituminous Coal on Anthracite Equipment by J. Ludden and W. N. Sims.
- SSSF6—Specific Problems Connected with Handling and Disposing of Combustion Refuse from Solid Fuels by L. E. Mylting.

1959 Annual Meeting

- | | |
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| 59F6 | 59F86 |
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| 59F26 | 59F90 |
| 59F30 | 59F92 |
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| 59F43 | 59F107 |
| 59F74 | 59F115 |

For a complete list of numbers, titles, and authors of SME Preprints from the 1959 Annual Meeting, turn to page 102 in the Directory Section.

**Mineral
Information
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Begins on
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659**



Coal miner at work serves as a reminder of the annual AIME-ASME Joint Solid Fuels Conference to be held this year in Cincinnati, October, page 726.

**Proposals for
Membership**

**Change of Address
Personals Data
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page 740**

DIRECTORY

SME's 1959 Membership Directory follows page 752 of this issue. The entire section, including covers, can be pulled out for handy and permanent reference. Your attention is called to page X of the Directory—here information is given regarding binders for the Directory. These binders are available from AIME at cost and you also may obtain the membership Directories of the other AIME Societies (Society of Petroleum Engineers and The Metallurgical Society). The SME Directory contains an introductory section—pages I to VIII—in which are listed SME and Division officers and committees, AIME Local Sections, Student Chapters at schools within the areas of SME interests, and AIME officers. The Directory proper is divided into two sections: Alphabetical listings of members and addresses (page I) and a Geographical section (page 103) where members are listed under state and/or country, city, and company. Those listed under "no data supplied" did not return the Directory information request cards mailed earlier this year.



Cincinnati's the City For Joint Solid Fuels

Planning continues at a steady pace for the Joint Solid Fuels Conference to be held in Cincinnati this fall. The AIME-ASME meeting will convene at the Netherland-Hilton Hotel from October 27 to 29.

Tentative topics under consideration include ash flow characteristics, burning fine sizes of coal, fuel constituents affecting boiler operation, and carbonizing properties of American coal.

The city of Cincinnati has many attractions for convention visitors.

Music, sports, and special events are available for weeknight entertainment. The Cincinnati Art Museum will have a special exhibit worth seeing. The Cincinnati Symphony Orchestra at Music Hall has many visiting artists in its varied program. The Museum of Natural History will reopen in the fall in a new location with modern facilities.

For dinner and dancing there are many night spots to tempt members and wives to relax after a day of busy sessions. For a taste of Morocco and Paris in one hop the Terrace Hilton Hotel suggests a drink at the Kasbah before dinner at the Gourmet, high above the city

where French cuisine is the specialty. The Maisonnnette also caters to continental appetites and is just a few steps from the Fountain Square, heart of the Queen City, where the Tyler-Davidson Memorial Fountain rises in tiers of stone and bronze. Dancing later in the evening draws the crowd to the Rainbow Club, and the added attraction of floor shows tempt the curious to Beverly Hills, the Cat & Fiddle, and the Glen Rendezvous.

Special events include horse shows, flower shows, and featured presentations at the University of Cincinnati. The ladies will enjoy shopping and fashion shows, plus luncheons at the Cincinnati Woman's Exchange where the gifts and bakery delicacies are hard to resist. Check with the Convention and Visitors Bureau at the Union Central Building when you arrive to discover the highlights of the week.

Further details of the conference will appear as final plans are formed. Watch each month for developments.

Penn State Will Host 9th Drilling Symposium

Exploration Drilling will be the topic of a three-day symposium to be held at Pennsylvania State University, October 8 to 10. Jointly sponsored by the departments of mining engineering at the University of Minnesota, the Colorado School of Mines, and The Pennsylvania State University, this will be the ninth annual Exploration Drilling Symposium held since its inception at Minnesota in 1950.

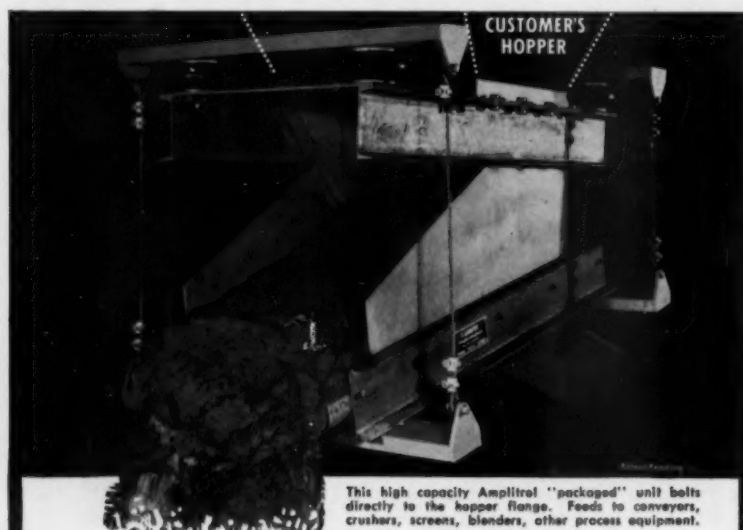
Five technical sessions will deal with statistics and operations research in exploration, bit design, and rock penetration, improving core recovery, drilling, and sampling of unconsolidated materials, and innovations and case studies in drilling practice. The program will be of interest to engineers, geologists, contractors, and operators.

The Exploration Drilling Symposium is one of three jointly sponsored by the three schools. Colorado was host for the Rocks Mechanics Symposium in April of this year and will hold the Drilling and Blasting Symposium in 1960.

Howard L. Hartman is head of the department of mining at the host school. For further details of the program and accommodations, contact Mr. Hartman at The Pennsylvania State University, University Park, Pa.

October is National Clay Conference Date

On October 12 to 14 the Eighth National Clay Conference will be held on the University of Oklahoma campus, Norman, Okla., under the auspices of the Clay Minerals Commission. (Continued on page 741)



This high capacity Amplitrol "packaged" unit belts directly to the hopper flange. Feeds to conveyors, crushers, screens, blenders, other process equipment.

"Feeder-Hopper Bottom Package" Reduces Design, Installation Costs!

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The Chairmen of the three Society Nominating Committees have announced nominations for AIME President-Elect, Vice Presidents, and Directors for 1960.

Each of the Society Bylaws provides for additional nominations. (The Bylaws of each Society in substantially final form have been published in the Journals and in revised form in the 1957 Institute Directory.) If no alternate slate is proposed, no letter ballot will be necessary and the selections of the three Nominating Committees will be declared elected in accordance with the respective Society Bylaws well in advance of their installation at the 1960 Annual Meeting in February in New York.



R. R. McNAUGHTON

Ronald R. McNaughton has been nominated for AIME President-Elect by The Metallurgical Society to take office as President in 1961. Mr. McNaughton is manager, Metallurgical Div., The Consolidated Mining & Smelting Co. of Canada Ltd. He served as chairman of the Extractive Metallurgy Div. in 1953. He has also been a Director of AIME. His positions with Consolidated during his 35 years of service have included assistant foreman, development engineer, assistant superintendent, and metallurgist. He was chief metallurgist until his promotion to manager in 1946.

Vice Presidents—Directors

J. W. Woomer, President of SME for 1959, is serving a three-year term on the AIME Board of Directors and has been nominated by the Society of Mining Engineers to serve as AIME Vice President. Mr. Woomer formed his own consulting firm in 1940 which has taken him round the world. Earlier he had worked for the Pittsburgh Coal Co. and the Hanna Coal Co.

S. D. Michaelson, Society of Mining Engineers President in 1958, has been nominated to serve as AIME Vice President for one year by the

THE THREE SOCIETIES PRESENT NOMINATIONS FOR THE 1960 INSTITUTE OFFICERS AND DIRECTORS



J. W. WOOMER



S. D. MICHAELSON



J. CHIPMAN



W. R. HIBBARD, JR.

Society of Mining Engineers. Mr. Michaelson did undergraduate and graduate work at Lehigh University and began with Bethlehem Steel Co. Since 1954 he has been chief engineer of the Western Mining Divs., Kennecott Copper Corp.

John Chipman, serving as AIME Director for three years, has been nominated by the Metallurgical Society for AIME Vice President for one year. Born and educated in Florida, he received a Ph.D. at the University of California. He became head of the metallurgy department at the Massachusetts Inst. of Technology in 1946.

Walter R. Hibbard, Jr., 1958 President of The Metallurgical Society, has been renominated as Vice President of AIME for another year by TMS. He is manager of alloy studies, General Electric Research Laboratory and adjunct professor of metallurgical engineering at Rennselaer Polytechnic Inst. He also has been asst. professor at Yale University.

John P. Hammond, 1957 President of the Society of Petroleum Engineers and member of the AIME Board of Directors, has been nominated by SPE as AIME Vice President for one year. He is assistant general superintendent of the Production Dept., Amerada Petroleum Corp. in Tulsa. He had been associated with his father as an independent oil producer.

Basil P. Kantzer, 1959 SPE President and member of the AIME Board of Directors, has been nominated by the Society of Petroleum Engineers as AIME Vice President for one year. He is vice president of Union Oil Co. of California and manager of its Gulf Coast Div. After graduating from Stanford University, he joined Union Oil as a roustabout.

Directors

R. H. Feierabend has been nominated by the Society of Mining Engineers to serve as Director for three years. He is a graduate of Columbia University School of Mines and assistant vice president of Freeport



J. P. HAMMOND



B. P. KANTZER

Sulphur Co. He has direct responsibility for Freeport's Grand Isle mine. **James C. Gray**, member of the SME Board of Directors, has been nominated by SME to serve as AIME Director for a three-year term. Mr. Gray graduated from Pennsylvania State University and worked for Hudson Coal Co. for 12 years. In 1937 he became superintendent of the Wylam mine for U. S. Steel Corp. and in 1958 administrative vice president, raw materials.

James B. Austin, vice president, research and technology, U. S. Steel Corp., has been nominated by The Metallurgical Society to the AIME Board of Directors. He had been TSM President in 1953. He received a Ph.D. in physical chemistry from Yale University and joined U. S. Steel in 1928.

J. S. Smart, Jr., has been nominated by The Metallurgical Society to serve on the Board of Directors, AIME, for three years. He gained his early experience with the Ford Motor Co. and Detroit Lubricator Co. before joining American Smelting & Refining Co. where he is now general sales manager.

H. F. Beardmore, manager of Gulf Oil Corp.'s Gulf Coast District, has been nominated by the Society of Petroleum Engineers as AIME Director for a three-year term. He was formerly vice president of Warren Petroleum Corp. which he had joined in 1947.

The second AIME Director representing the Society of Petroleum Engineers will be the 1961 President of the Society. The SPE Nominating Committee will announce his name in the fall and he will become an AIME Director, starting a three-year term in February 1960.



R. H. FEIERABEND



J. C. GRAY



J. B. AUSTIN



J. S. SMART JR.



H. F. BEARDMORE

SME ANNOUNCES NOMINATIONS FOR THE 1960 SOCIETY OFFICERS



J. C. GRAY

James C. Gray has been nominated for the office of President-Elect, Society of Mining Engineers, to take office as President in 1961. He is administrative vice president, raw materials, for U.S. Steel Corp. in Pittsburgh. After graduation from Pennsylvania State University, Mr. Gray worked for Hudson Coal Co. for 12 years. In 1937 he became associated with the Tennessee Coal & Iron Div. of U.S. Steel at Fairfield, Ala., as superintendent of the Wylam mine. Progressing through various management positions in coal and iron ore mining and manufacturing, he became manager of the division's manufacturing operations in 1950. Four years later he was named vice president of the coal division. Mr. Gray has been active in professional and civic associations, including the AIME Executive Committee, acting as chairman of the Southeast Section. He has also had memberships in the American Iron and Steel Inst.; the Coal Mining Inst. of America; and the Advisory Council of the Coal Div. of the American Mining Congress.

Nominated for the office of Vice President of the Western Regional Area for a three-year term is **H. Carroll Weed**. Born in Michigan, Mr. Weed is a graduate of the Michigan College of Mines. From 1925 to 1926 he was efficiency engineer and miner for Calumet & Hecla Mining Co. in the Ahmeek Branch. For the next ten years he worked for United Verde Copper Co. in Jerome, Ariz. Numerous jobs ranging from timber helper to shift boss gave him a backbone of experience. In 1937 he joined the Inspiration Consolidated Copper

Co. as shift boss and worked upward to his present position of general manager.

E. M. Spokes has been nominated by the Coal Division as a Director of SME for a three-year term. Born in Philadelphia, he studied at Lafayette College, the University of Kentucky, and received a Ph.D. from Pennsylvania State University. He worked for Bethlehem Steel Co. and National Lead Co. as mining engineer, foreman, and assistant superintendent. He had various teaching assignments while in the U.S. Army, and has been on the faculty of the University of Kentucky for the last ten years as professor of mining engineering.

The Industrial Minerals Div. nominee for SME Board of Directors is **Sanford S. Cole**, National Lead Co. Dr. Cole is a graduate of Alfred University where he obtained B.S. and M.A. degrees, continuing his studies at Pennsylvania State College to earn a doctorate in ceramics in 1934. He began in the Titanium Div. of National Lead in 1934, was research supervisor from 1945 to 1948, and became assistant manager of research last year. He is presently serving as trustee of Alfred University, a Director of AIME, and a member of the committee on education.

Nominated for the SME Board by the Minerals Beneficiation Div. is **Nathaniel Arbiter**, professor of mineral engineering at Columbia University. He received his degree from Columbia in 1935. He served with the Battelle Memorial Inst. and Phelps Dodge Corp. in Arizona and New York before accepting the post at his alma mater. He has been active in MBD since its founding and has been chairman of the ECPD New York Section and the AIME Technical Publications Committee.

R. D. Satterly has been nominated by the Mining & Exploration Div. to be SME Director. Born in Michigan, Mr. Satterly attended Michigan College of Mining and Technology, receiving B.S. and E.M. degrees. He was employed by Inland Steel Co. after graduation, successively as engineer, chief engineer, mine superintendent, general superintendent, and general manager of ore mines. He is now vice president and general manager of Caland Ore Co.



H. C. WEED



D. DAHLSTROM

Ltd., a subsidiary, and a director of several organizations.

Charles F. Park, Jr., also has been nominated for the SME Board by the Mining & Exploration Div. He received a B.S. degree in mining engineering from the New Mexico School of Mines in 1926, an M.S. from the University of Arizona in 1929, and a Ph.D. in geology from the University of Minnesota in 1931. He joined the U.S. Geological Survey and advanced from junior geologist to geologist in charge, Section of Metalliferous Deposits. In 1946 he became professor of geology at Stanford University and is now dean of the School of Mineral Sciences.

Donald Dahlstrom was appointed Director by the Coal Div. to fill the unexpired term of J. W. Woormer, SME President. Dr. Dahlstrom's term will end in February 1960. He received his doctorate from Northwestern University after undergraduate work at Macalester College and the University of Minnesota. He joined International Petroleum Co. Ltd. in Peru for three years and later spent ten years teaching at Northwestern where he was an associate professor in 1956. From 1953 on he was also director of research and development for The Eimco Corp.

Section 11 of Article IX, SME Bylaws, provides: "The names and biographies of the nominees shall be published in the July issue of MINING ENGINEERING. Any 25 members of the Society may submit additional nominations to the Board of Directors for one or more of the positions specified . . . [President-Elect and one Regional Vice President]. Such nominations shall be submitted not later than September of that year [1959], and notice of the additional nominees for the position or positions designated shall then be published in the October issue of MINING ENGINEERING. . . . If additional nominations are received, a letter ballot for the positions shall be sent on or about November 1 to all voting members of the Society in the United States, Canada, and Mexico. Ballots shall be returned within 45 days after they are mailed."



E. M. SPOKES



S. S. COLE



N. ARBITER



R. D. SATTERLY



C. F. PARK, JR.



COAL DIVISION NEWS



W. C. McCULLOCH

Nominee for Chairman-Elect of the Coal Division is **William C. McCulloch**. A graduate of the University of North Dakota, he received an M.S. at the University of Washington, where he held a U. S. Bureau of Mines fellowship at the Northwest Experiment Station in Seattle. Mr. McCulloch's first job was with Pacific Coast Coal Co. and in 1924 he went to work for USBM. A year later he joined Heyl & Patterson Inc. in Pittsburgh and in 1930 he became chief chemist for Koppers Rheola-veur Co. He took the position of preparation manager in 1935 for United Electric Coals Cos., and has served in that capacity with Roberts and Schaefer since 1941.

Nominated to serve on the Executive Committee of the Coal Div. for a three-year term is **Howard A. Herder**. Born in Illinois, he attended the Missouri School of Mines and Metallurgy. For one year he was with American Coal Co. In 1927 he joined Sahara Coal Co. Inc. in their Harrisburg, Ill., engineering depart-



H. A. HERDER



H. F. YANCEY

ment, and in 1931 he transferred to the fuel engineering department in Chicago where he is fuel engineer. An AIME member since 1938, he has been chairman of the Chicago Section. In 1945 he served on a commission appointed by the U. S. Army to study industrial coal burning plants in Germany.

Another nominee for the Executive Committee is **John L. Schroder, Jr.**, who was born and educated in West Virginia, receiving B.S. and M.S. degrees from West Virginia University. After graduation he joined U. S. Steel Corp. as junior engineer at the H. C. Frick Coke Co., Uniontown, Pa. In 1949 he was transferred to the Gary, W. Va., district as project engineer and advanced to chief engineer. In 1958 he was appointed general superintendent of the Lynch district, Lynch, Ky. Mr. Schroder is a veteran of World War II and a member of many civic and professional organizations.

H. F. Yancey has been nominated to serve as a member of the Execu-



J. L. SCHROEDER



H. O. ZIMMERMAN

tive Committee of the Coal Div. for a three-year term. A graduate of the University of Missouri with A.B. and A.M. degrees, he continued his studies at the University of Illinois where he earned a Ph.D. Since 1928 he has been superintendent, Northwest Experiment Station of the U. S. Bureau of Mines in Seattle. Presently he is chief of the Division of Solid Fuels Technology, Region 1, USBM. Mr. Yancey headed the Solid Fuels team of the U. S. Joint Chiefs of Staff in Germany in 1945. He is the former chairman of the Coal Div. and the author of nearly 100 publications on preparation and utilization of coal.

H. O. Zimmerman, now serving as Chairman-Elect of the Division, will become Chairman in 1960. He was born in Massachusetts, raised in New England until he went to the coal fields of West Virginia and Kentucky when he was 18. Mr. Zimmerman has been with Inland Steel Co. since 1930, first as chief engineer and then as assistant to the manager. He was named manager of coal properties in 1955. During World War I he was in the Navy and for a period after the War he was connected with the Kentucky State Highway Dept., the Illinois State Highway Dept., and the New York, New Haven, and Hartford Railroad. Mr. Zimmerman also did general engineering practice in his own business firm.

Coal News Editor

E. J. Sandy, assistant professor of mining engineering at West Virginia University School of Mines, has accepted appointment as editor of Coal Division News. Ideas and suggestions should be sent to him at Morgantown, W. Va. Coal News has been under the direction of George Keller, Div. secretary.

INDUSTRIAL MINERALS NEWSLETTER



R. H. FEIERABEND

The nominating committee of the Industrial Minerals Div. has prepared a slate of Divisional nominees to take office, if elected, in February 1960, and to serve for the 1960-1961 term. Nominated for chairman is R. H. Feierabend. Secretary-treasurer will be J. S. Holland.

The vice chairmen are chosen to represent designated areas of this country and Canada. T. E. Gillingham, Jr., has been named to represent the Northeast area. C. F. Clausen has been nominated for the Mid-Continent district. R. H. Wilpolt will serve in the Rocky Mountain area. From the Pacific Northwest T. J. Waters has received the committee's nomination. From the Pacific Southwest J. K. Brooke has been chosen. V. A. Haw has been nominated for the Canadian area.

Nominated to serve on the Executive Committee for a three-year term are Pauline Moyd, L. W. Dupuy, and R. F. Brooks. Other committees include the SME Transactions Editorial Committee with D. R. Irving chosen to represent IndMD. The SME General Editorial Committee will receive Q. D. Singewald as the IndMD nominee.

Finally for the SME Nominating Committee four IndMD members

have been chosen: John Broughton, J. B. Graham (alternate), M. L. Leonardi, and Vernon E. Scheid (alternate).

R. H. Feierabend, nominated as Chairman of the Division, is assistant vice president of Freeport Sulphur Co. in New Orleans. A native of Little Rock, Ark., he received A.B. and B.S. degrees from Columbia University, doing his graduate work at the Columbia School of Mines. He also attended the Advanced Management Program of Harvard Business School in 1955. He joined Freeport Sulphur in Hoskins, Texas, soon after his schooling and through a series of promotions from junior engineer to field engineer, production engineer, and on upward, he became general superintendent of the Grande Ecaille Mine in 1953. Mr. Feierabend has served on the National Membership Committee of AIME, and has worked in many official positions for the Institute. He has also been nominated by SME for a term on the AIME Board of Directors (see page 727).

John S. Holland has been nominated for the position of secretary-treasurer of the Division. A native of Kimberly, B.C., Canada, he graduated from the University of Idaho with a B.S. degree in geology, and worked as a geologist for Consolidated Mining & Smelting Co. at Kimberly and at Trail, B.C. In 1947 he returned to his alma mater for an M.S. and then joined Shenon & Full, consulting geologists, and Day Mines Inc., at Wallace, Idaho. In 1948 he became associated with National Lead Co. as chief geologist at the MacIntyre Development, Tahawus, N. Y. In 1952 he was transferred to the mining department in New York as technical assistant, and later became chief geologist.

These men have the background and experience to serve the Division well with the cooperation and support of all interested members.



J. S. HOLLAND



C. F. CLAUSEN



L. W. DUPUY



R. F. BROOKS

Australia Meeting Will Cover Hydrometallurgy

A Symposium on Hydrometallurgy entitled *Wet Processing of Minerals and Industrial Products* will be presented by the Australasian Inst. of Mining and Metallurgy on Feb. 16 to 19, 1960. It will be held in Adelaide and will be opened by two prominent authorities who will deliver review papers in the fields of fluid mechanics and unit operations.

The current world trend towards hydrometallurgical extraction processes continues to give rise to important new developments in wet process equipment and techniques. Twelve papers will review these developments. Authors were invited to submit papers in the following categories: wet sizing processes (classification, wet screening, etc.), agitation (leaching, mixing of slurries), liquid-solid separation (thickening, filtration), and recovery processes.

The Symposium will also include an inspection of plant, the Research and Development Section of the South Australia Dept. of Mines, which are the largest metallurgical research laboratories in the country.

Open forum discussions of the technical sessions and social functions will complete the program. Information concerning registration may be obtained by writing: The Aus. I.M.M. Symposium Secretary, C/ South Australian Dept. of Mines, Osman Place, West Thebarton, Adelaide, South Australia.



J. K. BROOKE



R. H. WILPOLT



V. A. HAW



P. MOYD

mBd'ers digest

MINERALS BENEFICIATION DIVISION



H. R. SPEDDEN

The Minerals Beneficiation Division has announced its slate of officers nominated to begin serving in February 1960.

The Nominating Committee has chosen H. Rush Spedden to serve as Divisional Chairman. Neil Plummer has been nominated as Associate Chairman, the position Mr. Spedden now holds, and Steve Erickson has been named to fill Mr. Plummer's present position of First Regional Vice Chairman. Second Regional Vice Chairman will be Walter Snively, who is now Secretary-Treasurer, and William T. Marston will take over Mr. Snively's post.

Committee chairmen have also been nominated to take office next year. Will Mitchell, Jr. has been chosen to head the Nominating Committee; Don Dahlstrom will be Chairman for Membership; Bunting S. Crocker will be in charge of Papers & Publications; Tom Morris will head the Education Committee; and John D. Hassialis has been nominated to be Chairman of Mineral Economics.

Further committee chairmen nominations include Don G. Ashe for Materials Handling & Storage. F. J. Windolph will be in charge of Crushing & Grinding. Clyde Osborn will deal with Solids-Fluids Separation. E. C. Tveter has been chosen

to head the Concentration Committee. H. E. Uhland will be in charge of Operating Control. F. T. Davis will be Chemical Process Chairman. Harold Rowen will take care of Pyrolysis & Agglomeration. Al Wallach will head Mill Design. And Phil deBruyn will be Chairman of Basic Science.

MBD representatives for SME include the following nominations: SME Nominating Committee, Nathaniel Arbiter, principal member; Neil Plummer, alternate; Wayne Dowdey, principal; and Steve Erickson, alternate. Robert Ramsey has been nominated for the SME Admissions Committee.

In accordance with the MBD By-laws, the Chairman of the Papers & Publications Committee, Bunting S. Crocker, will also serve as MBD representative on the SME Transactions Editorial Committee. The Second Regional Vice Chairman, Walter Snively, will serve as MBD representative on the SME General Editorial Committee. Neil Plummer, MBD Associate Chairman, will be head of the MBD Program Committee and will also serve as member of the SME Program Committee. Don Dahlstrom, MBD Membership Chairman, will also be MBD representative on SME Membership Committee. Tom Morris, MBD Education Chairman, will also be on the SME Education Committee, and John D. Hassialis will serve on both the MBD and SME Mineral Economics Committees.

The MBD representative on the AIME Rossiter W. Raymond Award Committee will be the Chairman of the MBD Papers & Publications Committee, Bunting S. Crocker.

The future Division Chairman, H. Rush Spedden, is a graduate of the University of Washington and the Montana School of Mines, and presently director of research for Union Carbide Ore Co. in New York. He went to MIT as research assistant in 1940 and two years later took a leave of absence to serve as metal-

lurgist with the U. S. Foreign Economic Administration in Bolivia. Following military service, he returned to MIT in 1946 as assistant professor of mineral engineering. He joined Union Carbide in 1952.

Neil Plummer, nominated Associate Chairman, is superintendent of the Arthur Plant, Kennecott Copper Corp., Magna, Utah. Educated at the Missouri School of Mines, he has worked for New Jersey Zinc Co., International Smelting & Refining Co., and Utah Copper Co. before advancing with Kennecott.

Stephen E. Erickson, nominated to serve as First Regional Vice Chairman, is a graduate of the University of Minnesota School of Mines as a metallurgist. At the present time he is beneficiation engineer with the M. A. Hanna Co., Hibbing, Minn.

Second Regional Vice Chairman nominee, J. Walter Snively, is assistant division manager for Chain Belt Co. where he has served in various positions. He graduated from the University of Wisconsin in 1927 and was on the faculty of the University of Illinois. He is the author of numerous technical papers on bulk conveying.

William T. Marston, area manager of industrial sales, Dorr-Oliver Inc., and native of Ontario, Canada, has been nominated as MBD Secretary. He graduated from the University of Toronto in 1949 and joined Dorr-Oliver as mining engineer. He has worked in Denver and California for the firm.

Earthquake Conference

The Second World Conference on Earthquake Engineering will be held in Tokyo and Kyoto, Japan, from July 11 to 16, 1960. Organized by the Science Council of Japan, it is being planned in cooperation with the Japan Soc. of Civil Engineers, the Architectural Inst. of Japan, and the Seismological Soc. of Japan.

The objectives of the conference are to exchange knowledge and experience for the purpose of minimizing earthquake hazards, to obtain information on research in engineering seismology and new developments in aseismic design and construction practices in seismic countries.

For information on papers and arrangements, write to: Professor Kiyoshi Muto, chairman, Organizing Committee, Second Conference on Earthquake Engineering, Science Council of Japan, Ueno Park, Taito-ku, Tokyo, Japan.



N. PLUMMER



W. SNAVELY

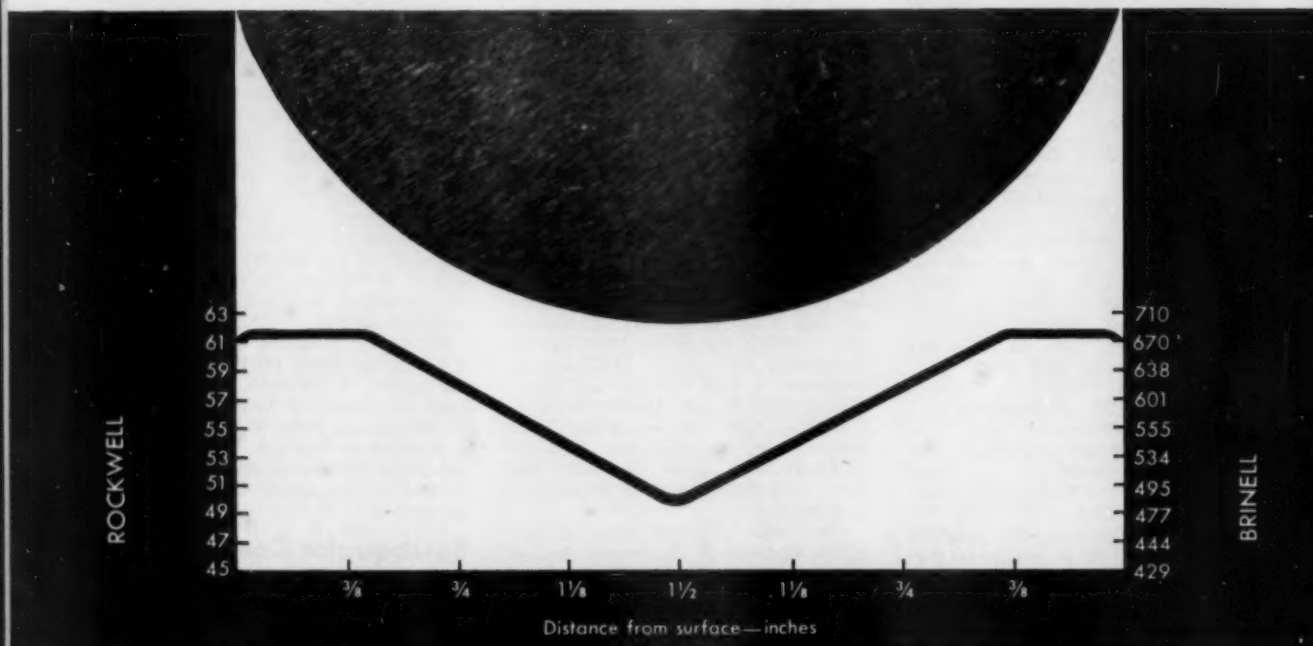


W. T. MARSTON

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Mining & Exploration Division

The Mining and Exploration Div. Nominating Committee has been hard at work studying the selection of men for nominations. They have prepared a slate for 1960 officers that begins with Robert J. Lacy as Chairman. Assistant Chairman will be John G. Hall. J. M. Ehrhorn has been nominated as Vice Chairman in charge of programs, John C. Wangaard as publications Vice Chairman, and Peter Joralemon for membership Vice Chairman. Nominated to serve three-year terms as SME Board members are R. D. Satterley and Charles F. Park, Jr. (see page 728).

R. J. Lacy, nominated for the position of Chairman of M & E, is chief geophysicist for American Smelting & Refining Co. in Salt Lake City. He has been Assistant Chairman of the Division under Lyman Hart. A graduate of the University of Minnesota in 1937, Mr. Lacy began his career as mine geologist for The Anaconda Co. in Butte, Mont. In 1946 he joined the California Co. as a geological observer on exploration parties. He returned to his alma mater in 1947 for postgraduate work, accepting a post as geologist with Asarco in 1948.

Nominated as Assistant Chairman is **John G. Hall**. Born in Omaha, Neb., he attended public schools in Omaha; Perth Amboy, N. J.; and Salt Lake City, and graduated from the University of Utah in 1939 with a degree in mining engineering. He started working for the U. S. Smelting Refining & Mining Co. that same year as a mucker and advanced to mine foreman, geologist, and efficiency engineer in the Tintic and Bingham mining districts. In 1946 he became general superintendent of the Chief Consolidated Mining Co. operations in Eureka, Utah. In 1952 Mr.

Hall joined National Lead Co. as assistant plant manager of the titanium plant in Tahawus, N. Y., and in 1955 he was appointed plant manager. Mr. Hall has served AIME as program chairman, Adirondack Section, on the Mining Branch membership committee, and has written several articles for mining publications in addition to duties for M & E.

Vice Chairman responsible for the programs of the Division is **Jack M. Ehrhorn**. He has held this position during 1959. Mr. Ehrhorn graduated from Stanford University with a degree in mining engineering in 1927. He gained his early mining experience working as a miner, timberman, and shift boss with United Verde Copper Co. in Jerome, Ariz.; in the North Fork Placer mines at Helena, Calif.; and the Idaho Maryland Mines Corp. in Grass Valley, Calif. In 1938 he formed a partnership with H. F. Lynn and entered the consulting field as an engineer and geologist. In 1942 he joined Western Knapp Engineering Co. as mine plant construction superintendent and for two years was in charge of field construction projects in California, New Mexico, and Colorado. He joined U. S. Smelting Refining & Mining Co. as industrial relations engineer in 1944 and was advanced to superintendent of the U. S. section of the U. S. and Lark mine in 1945. From there he advanced to assistant to the manager of mines. In 1953 he was given the position that he now holds, director of industrial development.

Nominated for Vice President in charge of publications is **John C. Wangaard**, who has held the position of M & E membership Vice Chairman during the past year. Mr. Wangaard is superintendent of the

EDITOR

Address news items to:

John W. Chandler, American Metal Climax Inc., 61 Broadway, New York 6, N. Y.



Gary mine of the Odanah Iron Co., Hurley, Wis., and the Peterson mine of the Puritan Mining Co., Bessemer, Mich., both underground iron ore mines managed by Pickands, Mather and Co. on the Gogebic iron range. He was born in Minneapolis and graduated from the University of Minnesota School of Mines in 1935. He joined Lamaque Mining Co. Ltd. after leaving college to work in their gold mining operations in Quebec. He moved to Vermont Copper Co. in 1944 as chief engineer and was promoted to mine superintendent. In 1951 he joined Pickands Mather as operating assistant in the district office at Ironwood, Mich., and advanced to his present post.

Peter Joralemon has been nominated as Vice President of membership. He received his education at Yale University and Harvard University, where he earned M.A. and Ph.D. degrees. His experience included three years as geologist with the U. S. Geological Survey, a year at Getchell mine in Nevada and five years with the New Park Mining Co. where he became superintendent. From 1955 on he has been a consulting geologist. He has been a member of the board of directors of New Park Mining Co. and of the Lucky Mc Uranium Co.

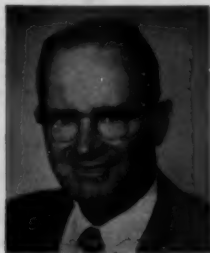
The Nominating Committee feels that these men qualify by their experience and interest to serve the Division in their respective offices.



R. J. LACY



J. G. HALL



J. M. EHRHORN



J. C. WANGAARD



P. JORALEMON

Mining Standards Board Reports Recent Actions

Since its last report to the Standards Council, the Mining Standards Board has held three meetings, in October 1957, May 1958, and October 1958. The officers elected for 1959 are Paul T. Allsman, chairman, and Joshua Smith, vice chairman.

Approval was voted for the proposed reaffirmation of *American Standard for Construction and Maintenance of Ladders and Stairs for Mines*. The recommendation to discontinue project M14, *Use of Explosives in Bituminous Coal Mines*, was approved. Other actions taken include approval of the proposal to reorganize projects M15 and M18 on coal and metal mine transportation, title and designation of reorganized project M31, *Recommended Safe Practices for Underground Mine Transportation*. Also approved was the proposal to discontinue project M27, *Use of Explosives in Anthracite Mines*.

It was recommended to the Board of Review that the following two proposed standards be approved as American Standard: 1) *Construction and Maintenance of Rail Haulage Roads in Coal Mines*, M7.3; and 2) *Roof Bolting Materials for Coal Miners*, M30.1

It was also recommended to the

Board of Review that the following American Standards be withdrawn: 1) *Frogs, Switches, and Turnouts for Coal Mines and Tracks*; 2) *Frogs, Switches and Turnouts for Coal Mine Tracks for 70-lb and 80-lb Rail*; 3) *Recommended Practice for the Use of Explosives in Bituminous Coal Mines*; 4) *Recommended Practice Safety Code for Coal Mine Transportation*; 5) *Recommended Practice for Fire Fighting Equipment in Metal Mines*; and 7) *Recommended Practice for Mechanical Loading Underground in Metal Mines*.

The AIME representatives to the American Standards Assn. are: E. R. Borchardt, December 1959; Otto Herres, December 1959; J. K. Richardson, December 1960; and the alternate, E. W. Bullard.

ECPD Offers Brochures For Recent Graduates

Three new brochures with pointers for engineers during their first few years after graduation are now available from the Engineers' Council for Professional Development.

Your First Five Years outlines the challenge to your graduates and suggests a six-point professional development program that encourages continuing education, responsible citizenship, reading, and personal appraisal.

Selected Reading for Young Engineers emphasizes the fact that today's engineers must be well rounded, with reading knowledge in fields outside their own.

Personal Appraisal is the third publication, a questionnaire to help evaluate progress periodically and plan future steps in professional development.

All these publications may be purchased separately or in the manual, *A Professional Guide for Young Engineers*. Order copies from ECPD, 29 W. 39th St., New York 18, N.Y.

Prepublication Special For Minerals Volume

The third edition of *Industrial Minerals and Rocks* is scheduled for publication in late summer 1959. The selling price for the book to nonmembers will be \$12. AIME members will receive a 30 pct discount, bringing the price down to \$8.40, delivery postpaid. Libraries (other than company libraries) will receive the same discount.

A prepublication offer will go out to all members of AIME by June 15th. If anyone orders and sends in his check he can receive the book for \$7.90, delivery in September. Such orders will be honored until Sept. 15, 1959.

Opportunity for Schools

Any member of AIME can order

any number he wants at the discount price. A professor who is a member and wishes to use the book in his classes can order any number up to September 15 at \$7.90.

AIME

BOARD OF DIRECTORS

Recent actions taken by the Institute Board of Directors.

► By mail ballot, the Board of Directors has approved requesting approximately \$7500 from the National Science Foundation to publish and distribute a brochure on *Careers in Metallurgical Engineering*.

► The recipient of the McKune Award for 1959 is G. M. Hagenberger, Standard Steel Works Div., Baldwin-Lima-Hamilton Corp., for his paper *Conversion to 70 pct Natural Gas Utilizing a Continuous Oxygen and Combustibles*.

► S. F. Kelly has resigned as AIME representative on the American Standards Assn. Sectional Committee C-61, Electric and Magnetic Magnitudes and Units. Robert J. Searles of Newmont Mining Co. was appointed to replace Mr. Kelly.

► The date of the 1961 AIME Annual Meeting in St. Louis has been changed from the week of February 19 to February 26, with the Chase-Park Plaza Hotels as headquarters.

► Revised Bylaws of the Mid-Continent Section have been received, are in order, and are approved.

► Since the terms of AIME representatives on the American Assn. for the Advancement of Science Board have expired, the suggestion was approved to appoint F. T. Agthe for one year to December 1959, and W. L. Fink for two years to December 1960.

► R. R. McNaughton has been appointed chairman of the Douglas Gold Medal Committee, 1959, to replace Earl Palmer who was unable to accept the appointment.

► Philip Kraft has been reappointed to a three-year term on United Engineering Trustees Inc. as AIME representative.

► Paul R. Nichols attended the dinner for the presentation of the Washington Award for 1959 to James R. Killian, Jr., held in Chicago on April 13.

► Through the generosity of Ingersoll-Rand Co., sufficient funds will be available for the presentation of the William Lawrence Saunders Gold Medal in 1960.

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COAL-IndMD BEDFORD SPRINGS, PA., JOINT MEETING

Thursday, September 24, AM

Industrial Minerals Division

Howard Hartman and Don Irving, Co-Chairmen
Structural Concrete made with Lightweight Aggregates: *Joseph J. Shideler*, Portland Cement Assn.
Limestone Mines—Their Commercial and Strategic Potential: *Russel W. Hunt*, Southwest Lime Co.
Curtain Walls of Indiana Limestone: *Jasper D. Ward*, architect.
Competition of Artificial Dimension Stone: *W. F. Mul-len*, Pennsylvania Slate Producers Guild Inc.

Thursday, September 24, PM

Industrial Minerals Division

W. E. Brownell and R. S. McClellan, Co-Chairmen
Gypsum in Indiana: *R. A. Teichman, Jr.*, and *W. B. Fergusson*, Pennsylvania Railroad Co.
Quality Control In Refractory Raw Materials: *O. M. Wicken* and *C. P. Cook*, Harbison-Walker Refractories Co.
Study of the Mechanism and Rate of Ilmenite Weathering: *Langtry E. Lynd*, National Lead Co.
The Role of Technical Fiber (Asbestos) Sales In Today's Market: *D. L. Monroe*, Canadian Johns-Manville Co.

Coal Division

Jim Elkins and H. E. Mauck, Co-Chairmen
The Application of Flocculants to the Clarification of Coal Washery Waters: *K. C. Lindstrom* and *R. H. Oliver*, Dorr-Oliver Inc.
Recovery of Solids from Water Systems, Wharton No. 2 Plant: *R. L. Llewellyn*, Eastern Gas and Fuel Assocs.
Maintenance of Water Clarification Equipment: *J. J. Reilly*, Jones & Laughlin Steel Corp.
Some Geological Factors Affecting the Upper Freeport Coal and its Quality: *Edwin F. Koppe*, Bureau of Topographic & Geologic Survey, Harrisburg.

Friday, September 25, AM

Joint Session—Coal and IndMD

H. E. Mauck and Henry Hebley, Co-Chairmen
Acid Mine Drainage: *S. A. Braley*.
The Influences of Bacteria on the Formation of Acid Mine Drainage: *William Leathen*.
Pennsylvania Regulations on the Formation and Control of Acid Mine Drainage: *L. E. Morgan*.
Discussion of the Legal Aspects of Pennsylvania's Regulations: *Robert Trace*.

Friday, September 25, PM

Joint Session—Coal and IndMD

Henry Hebley and Leon Dupy, Co-Chairmen
A Case History of a Difficult Mine Drainage Problem: *Ernest P. Hall* and *John Rosance*.
Field Trip Preview: *Carlyle Gray* and *Arthur R. Socolow*, Pennsylvania Geological and Topographical Survey.
Disposal of Sulphur Mine Effluents—How Freeport Solved Its Effluent Problems: *Paul D. Bybee* and *Frederick G. Deiler*, Freeport Sulphur Co.

Social Events

Wednesday evening: Free hotel movies
Thursday 12:30 PM: Luncheon—*J. W. Woomer*, speaker; *Responsibilities of Managements for Future Investments*.
Thursday afternoon: Ladies golf
Thursday evening: Cocktail Party
Friday 12:30 PM: Luncheon—*R. F. Birch*, speaker; *Research in Refractories*.
Friday afternoon: Ladies bridge
Friday evening: Dinner and dancing outdoors

Name _____
Company _____
Address _____

REGISTRATION

IndMD—Coal Divisions Joint Meeting
Bedford Springs, Pa.
September 24 to 26, 1959

Please fill out and mail both cards to:

John J. Schanz, Jr.
206 Mineral Sciences Bldg.
The Pennsylvania State University
University Park, Pa.

—Advance Member Registrations @ \$5.00 \$_____
—Advance Nonmember Registrations @ \$8.00 \$_____
—Advance Student Registrations, free @ \$1.00 \$_____
—Advance Ladies Registration @ \$1.00 \$_____
Checks should be made payable to E. H. Johnson, Treasurer

Name _____ Company _____
Address _____

FIELD TRIP REGISTRATION

Saturday, September 26

9:00 am to 12:30 pm

Aschom Plant, New Enterprise Stone & Lime Co.

Tatesville Plant of Pittsburgh Silica Sand Co. @ \$1.00 \$_____

Checks should be made payable to E. H. Johnson

MAKE PLANS NOW FOR FALL AT BEDFORD SPRINGS

Bedford Springs, Pa., will welcome members of the joint Coal Division and Industrial Minerals Division meeting from September 24 to 26. Now is the time for registration and hotel arrangements for all who wish to attend.

Registration fees are \$5 for members, including the preprint booklet worth \$2.50, \$8 for nonmembers, \$1 for the ladies; and students are invited to participate free of cost. Advance registration should be sent to John J. Schanz, Jr., 206 Mineral Sciences Bldg., The Pennsylvania State University, University Park, Pa. Field trip tickets should be purchased in advance. Checks should be made payable to E. H. Johnson, Treasurer, Bedford Springs Meeting.

All events will take place at the Bedford Springs Hotel. Early reservations will be necessary to make accommodations. Bedford Springs rates and those of other hotels in the area are listed below:

Hotels	Single	Twin
Bedford Springs	\$15*	\$18*
Fort Bedford Inn	4.75-7	8.50-10
New Hoffman Hotel	4.50-7	8.-10
Penn Bedford Hotel	4-5	7.50-8

* Per person rate includes meals. Add to this rate Pennsylvania sales tax, 16 pct to cover gratuities, and \$1.25 per person for the Friday night dinner.

Motels		
Bedford Village	5	6.50
Bennett Motor Court	6-7	7-8
Crinoline Courts	8	9-10
Green Acres	6	8-9
Janey Lynn	6	8-9
Judy's	4	6
May Fair	7	8
Midway	8	9-10
New Hoffman Motel	6-7	8-10
Penn Manor	8	10
Pines Motor Lodge	6	10
Roll Arena	6-7	7-8
Stone Crest	7	10-11

Terrace	7	8-9
Valley View	5	6.50-8.50

Registrants should take care of their hotel reservations personally by writing to the hotel of their choice. Those who get the general mailing information will get a reservation blank for the Bedford Springs Hotel. Meeting registrants not staying at the Bedford Springs Hotel will be charged \$3 per luncheon and \$6 for the Friday night dinner.

The field trip will be conducted by Carlyle Gray and Arthur Socolow of the Pennsylvania Geological and Topographical Survey. A limited number of tickets will be available for \$1. Only one bus, seating 62, will be sent. It will leave the hotel at 9 am Saturday and return by 12:30.

Tour visits will include the Aschom Plant of the New Enterprise Stone & Lime Co. The quarry shows selective mining of certain limestone beds for crushed rock and certain beds for lime rock. The crushed rock plant demonstrates modern crushing and sizing equipment, operation of vertical kiln, hydrating unit, packaging of agricultural, chemical, and industrial lime.

A second stop will be the Tatesville plant of Pittsburgh Silica Sand Co. The quarry in the Oriskany formation demonstrates quality control. The plant shows crushing, washing, drying, screening, and iron decontamination techniques.

Social events will fill the in between moments. There will be free movies at the hotel on Wednesday evening for early arrivals. The luncheon on Thursday will be highlighted by guest speaker J. W. Woomeer. R. E. Salvati will preside.

Thursday afternoon will be free time for the ladies to practice golf

or entertain themselves beside the hotel pool. In the evening a cocktail party will be held outdoors if there is pleasant, Indian Summer weather.

On Friday the ladies may play bridge during the lazy afternoon after the luncheon. J. G. Broughton will preside at the luncheon, introducing R. F. Birch of Harbison-Walker Co. as the speaker. A strictly informal dinner will highlight the day, with dancing outdoors in the evening if the weather permits.

Saturday morning will tally up the men's golf scores for tournament prizes to end the conference.

Leon W. Dupuy is chairman of the program committee for IndMD, in charge of all the details and arrangements. He emphasizes the value of preprints available before the conference. Authors who get their papers in early will benefit by having their papers preprinted; members expecting to attend will benefit by reading the abstracts in MINING ENGINEERING and ordering preprints so that they will be prepared with questions at the time of the sessions. At the end of the technical sessions all the authors of the day will be on the rostrum to answer your questions. General discussion will be led by the "needle team" of Ernest P. Hall, Robert Trace and John Rosance, whose topics are listed on the program. Be sure that you are ready with provocative questions. Order your preprints this month.

Also hard at work making arrangements are E. E. Mauck, program chairman of the Coal Division, John Schanz, Jr., and Edward G. Fox, Co-Chairmen of the joint meeting.



First stop on the field trip will be the Aschom plant of the New Enterprise Stone & Lime Co., left, where selective mining of limestone beds produce crushed rock and lime rock. Next will be the Tatesville quarry of Pittsburgh Silica Sand Co. where the Oriskany formation demonstrates quality control. The plant shows iron decontamination techniques. Both tours will highlight the meeting.

Scholarships

Columbia University

The Seeley Wintersmith Mudd Memorial Scholarship Endowment Fund has been established at Columbia University to provide many scholarships annually, ranging from \$500 to \$1500. The Mudd Foundation has made many contributions to mineral engineering as memorials to a pioneer in the industry.

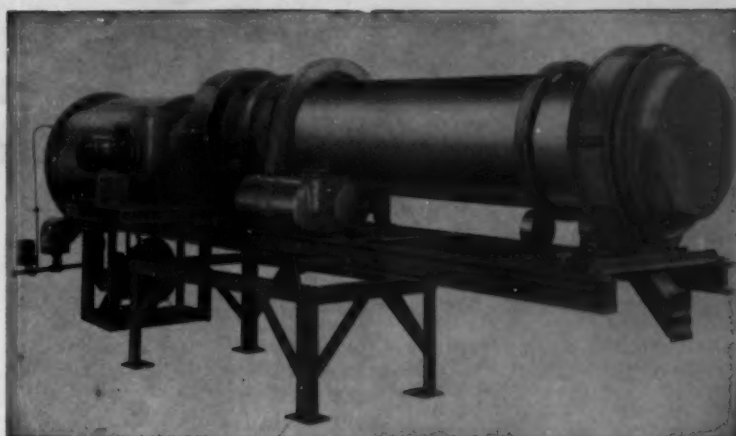
• A \$200 scholarship given to Henry Krumb in 1898 prompted the generous bequests recently received by Columbia University. "I would not have been a mining engineer if I had not had a scholarship which paid my tuition fee," he stated in his will. In addition to the major bequest reported in *Education News*, Mr. Krumb gave \$500,000 to establish the Krumb Chair of Mining, and another \$100,000 to be added to the Henry Krumb Mining and Metallurgical Scholarship Fund which he established in 1945.

Montana School of Mines

Ten \$500 scholarships will be awarded to freshmen entering the Montana School of Mines for the academic year 1959-1960. They will be awarded to students of high scholastic attainment who intend to major in one of the fields of the mineral industries. This is the first time that these scholarships have been made available. Interested students should apply to Professor W. M. Brown, Chairman, Scholarship Committee, Montana School of Mines, Butte, Mont.

U. S. Government Awards

The Fulbright fellowships for lecturing or advanced research in Europe, the Near East, Africa, and the Far East have been announced. Fellowships in geology, mineralogy, and geophysics are available in Austria, Belgium, Denmark, France, Germany, Finland, Iceland, The Netherlands, Norway, the United Kingdom, and Japan. To be eligible applicants must be American citizens, have one year of college teaching experience to apply for a lecturing fellowship, or a doctorate to apply for a research fellowship. Round-trip travel is provided and a year's tenancy in the foreign country with a maintenance allowance and small incidental allowance. Closing date for applications is Oct. 1, 1959. For forms and additional information, write: Conference Board of Associated Research Councils Committee on International Exchange of Persons, 2101 Constitution Ave., Washington 25, D.C.



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The Ruggles-Coles Pilot Plant Dryer is designed especially for laboratory use or for small capacity unit operations requiring a continuous or intermittent drying step. Each unit:

- Is mounted on a structural steel base.
- Has removable "knockers."
- Provides for easy changing of shell rotation speed or shell slope.
- Is available in stainless steel or other corrosion-resistant materials.
- Requires only fuel supply and power connections to be placed in operation.
- Is easily moved from place to place.

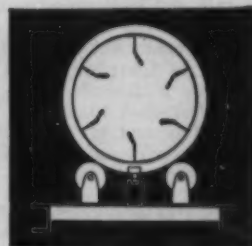
It is available in three models:

(1) XH-XF single-shell, direct gas fired dryer. Arranged for either parallel or counter-flow operation. Bulletin AH-471.

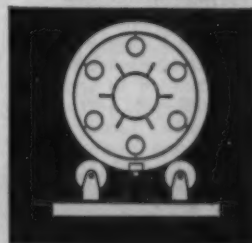
(2) XB double-shell, indirect-heat, gas-fired dryer for drying without contamination. Volatiles removed with only limited dilution. Bulletin AH-472.

(3) XC steam-tube indirect heat dryer. Can be connected to any available steam supply or furnished with a 3-HP steam generator. Bulletin AH-473.

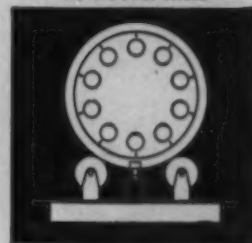
For complete information write Department 2.



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- The usual monthly dinner meeting of the **Yavapai Subsection**, Arizona Section, was held at the St. Michael Hotel on May 4th. In addition to the regular members, 12 graduating seniors from the Prescott Senior High School attended as guests. These students, who had taken the engineering and science preparatory option while in high school, were accompanied by Waldo Bast, their chemistry and physics instructor. The program consisted of brief talks on the mining and mineral industries given by Louis Bombardieri, Alba Jeffers, and Arthur Still.

- A talk and slide presentation were featured at the May 12 meeting of the **Morenci Subsection**, Arizona Section, at Longfellow Inn. Linton Claridge, a farmer from Safford, Ariz., described his trip to Russia. C. C. Riley and M. D. Hughes also made a report on the tour of Ajo concentrator.

- The annual field trip of the **Washington, D. C., Section** included the Chestnut Run Laboratories and the Experimental Station of E. I. du Pont de Nemours & Co. Inc. The laboratories deal primarily with technical assistance to sales and research related to end use performance. Research at the Station, and the Lavoisier Library were subjects of the second tour on June 2.

The May 5 meeting featured Charles H. Johnson of the Bureau of Mines in a talk on his recent assignment to the United Nations Technical Assistance Administration. Mr. Johnson spent two years in India as advisor to their government.

- A surprise "despedida" was held for Mr. and Mrs. Walter King of the **Lima, Peru, Section** when Mr. King retired as secretary and left for a long vacation in England. The cocktail party took place at the Hotel Columbus on May 6.

- The **San Francisco Section** sponsored an address on the *Future of Atomic Power and the Use of Nuclear Fuel* by E. W. O'Rourke, manager of Fuels and Materials Engineering for General Electric Co., San Jose, Calif. Mr. O'Rourke discussed boiling water reactor development at the meeting, May 13.

- The **Golden Gate Subsection**, San Francisco Section, heard James E. Lindsay, Standard Oil Co., on *Hydrocarbon Reserves—Their Estimation, Use and Misuse* on May 21 at the Bellevue Hotel.

- **W. R. Hibbard, Jr.**, AIME Vice President, visited the **Tri-State Section** and gave the address for the annual ladies night dinner on May 6 in Miami, Okla. Mr. Hibbard, metallurgist for General Electric

Co., was a member of the 11-man metallurgy group that toured Russia. His impressions of the Russian people provided an interesting evening. "The Russians are better off now than they have ever been in the memory of most of their citizens . . . They have a deep devotion to Mother Russia and are convinced that whatever is best for Russia is best for the world and honestly feel that Communism provides the best way of saving the world," Dr. Hibbard stated.

- The **Utah Section** officially welcomed springtime in the Rockies with the annual spring dinner-dance on April 18. A cocktail hour was followed by a delicious buffet dinner. Dancing in the Newhouse Hotel Crystal Ballroom completed the evening. Chairman for all arrangements was Jim Van Stone, who was ably assisted by Sid Alderman and Allen Jaeger.

- The annual dinner-dance of the **St. Louis Section** on May 8 featured W. R. Hibbard, Jr., for an illustrated talk on research in physical metallurgy in Moscow, Leningrad, and Sverdlovsk. The presentation of two awards also highlighted the evening. Norbert F. Neuman, research supervisor, Mallinckrodt Chemical Works, was awarded the Robert Lansing Hardy gold medal for 1958. Louis J. Kuest, Jr., was awarded \$100 for his student prize paper *The Minck Station Anomaly*. Cocktails and dinner were held at the Missouri Athletic Club.

- Under the chairmanship of Ernest Ohle, the program committee of the **Upper Peninsula Section** arranged the annual Spring Technical Session for May 16. J. R. Van Pelt welcomed the registrants and papers got under way in the morning. James P. Pollock presented *The Case History of the Discovery of the Marquez Mine near Grants, New Mexico*. R. D. Satterley and P. D. Pearson showed slides of the Caland Ore Co. Ltd. project at Steep Rock Lake, Ontario. And Robert Winchell discussed Groveland pegmatites. A business meeting followed the coffee break and a tour of the Ranger III, the Isle Royale National Park Service's new boat, completed the morning's activities. After the luncheon, Roger V. Pierce, AIME Vice President, addressed the Section members and wives.



The former president and present director of the Old Timers Club, Gene H. Jenks, congratulates Warren H. Nangle, left, as the "most outstanding senior mining engineering student" at Ohio State University. An engraved watch was awarded to Mr. Nangle, who is president of the Student Chapter of AIME, member of the Student Senate, and vice president of Engineers' Council. At right is J. R. Lucas, professor.

MBD Presented Annual "Rush to the Rockies"

The Colorado MBD Subsection, Colorado Section, held its annual business and technical meeting at the Broadmore Hotel in Colorado Springs on April 18. After early morning registration, a business meeting was held for the men while the ladies enjoyed get-acquainted coffee. An afternoon technical session and dinner-dance were the main features of the program.

Elections occupied the business session with the following officers nominated and elected for the forthcoming fiscal year: chairman, Ralph C. Toerper; vice chairman, Jack Melin; and secretary-treasurer, John W. Barnes. Neil Plummer, regional vice chairman of SME's MBD, outlined the current activities and plans of the organization in addition to stressing some timely topics for Local Section consideration.

Technical Sessions

Technical programming was under the general chairmanship of S. Power Warren. Session I concerned operating controls and Frank Windolph, Climax Molybdenum Co., was chairman. *Instrumentation in the Ambrosia Lake District* was the first paper, presented by Clyde Osborn and Harvey Bird, Homestake-New Mexico Partners. *Operation Controls and Ore Dressing* was next, by John Barnes, U. S. Atomic Energy Commission. Wayne Hazen and S. Power Warren then discussed *The Mill with No Operators*, and the session was closed by Frank Windolph with *Operating Controls at Climax Molybdenum Mill*.

Session II covered preventative maintenance with W. L. Jude, New Jersey Zinc Co., as chairman. He introduced the first speaker, R. W. Younger, who discussed preventative maintenance in concentrating plants and chemical plants. Robert Jones followed with the paper *A Guide to the Use of Protective Coatings*. F. J. Witthauer and H. Stienmier covered preventative maintenance where they work, the Eagle mine of the Empire Zinc Div., New Jersey Zinc Co.

Employee education was the topic of Session III. Dale C. Mathews, The Anaconda Co., acted as chairman. Hugh Matlock discussed new employee training at Climax Molybdenum Co. and Dale Mathews presented the paper *Anaconda's Blue-water Pilot Mill*. The technical session was completed by the paper *Professional Education and Practical Training: An Answer to a Dilemma*, given by Truman H. Kuhn, dean of the Colorado School of Mines.

More than 115 members and guests attended the dinner-dance in the Blue Room of the hotel.



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Personals

Robert C. Sullivan, formerly associate counsel in Kennecott Copper Corp.'s legal department in New York, has been appointed legal counsel for the Western Mining Divs. with offices in Salt Lake City.

J. McLaren Forbes is on a consulting job for Cerro de Pasco Corp. and will be working for them out of New York for the next ten months. He had been chief geologist for Consolidated Coppermines Corp., Kimberly, Nev.

Carlos R. Tapia C. is presently engaged in running two properties for Consorcio Minero del Peru as general superintendent of operations.

David McRae Irwin has become a sales engineer for W. S. Tyler Co., representing the firm in eastern Kentucky and West Virginia. He had been employed by Reliance Electric & Engineering Co. in Euclid, Ohio. His home now is in Charleston, W. Va.

K. Martin Köhler completed his studies toward an M.S. degree at Missouri School of Mines and re-

turned to Berlin where he will work for his doctorate.

W. F. A. Stolk, formerly assistant to the chief metallurgist for N. V. Billiton Co., immigrated from Holland in January to become metallurgist for Union Carbide Nuclear Co., Hartford, Conn.

Harold T. Blackwood, consulting engineer for U. S. Steel Corp., has accepted the position of director, Raw Materials Planning, in Pittsburgh.

R. Patterson, formerly vice president of Intrusion Prepakt Inc., has become vice president of Tretol Inc. which has just started in the U. S., distributing and manufacturing products for concrete construction.

Peter H. Cooper is the overseas liaison engineer for Dowty Mining Equipment Ltd., England. He had been the Middle East representative for Joy International.

Reuben D. Larsen, safety engineer for Kennecott Copper Corp., has been promoted to safety director.



J. C. RUSSELL



G. R. SCHAEFER

John C. Russell of Singmaster & Breyer has been named project engineer for an addition to a fuels technology center that the firm is designing for the Argonne National Laboratory.

George R. Schaefer, formerly general superintendent for National Lead Co., Baxter Springs, Kan., is now a mining consultant with offices located at Fourth and Cherokee, Baxter Springs. He will specialize in efficient mine mechanization, roof support, organization, and allied mining problems.

William R. Mehrhoff, formerly a student, now is field engineer for Universal Atlas Cement Div., U. S. Steel, in New York.

W. Julian Parton has been elected vice president, operations, of The General Crushed Stone Co. He has been assistant to the president and member of the board of directors.

PROPOSAL FOR AIME MEMBERSHIP

I consider the following person to be qualified for membership and request that a membership kit be mailed to him:

Name of Prospective Member:

Address

Name of AIME Member:

Address

SME

CHANGE OF ADDRESS AND PERSONALS FORM

CHANGING YOUR ADDRESS? Don't forget to notify us six (6) weeks before you move, if possible, to insure uninterrupted receipt of your publications and correspondence. Please fill in the form below and send it to: J. F. Lynch, Asst. Treasurer AIME, 29 West 39th Street, New York 18, N. Y.

Name _____
 Old Address _____

 New Address _____

 Company _____
 Address _____

PERSONALS: Please list below your former company and title and your new title and company (or new work) for use in MINING ENGINEERING. (Copy deadline for personals items is six weeks before date of issue.)

Former Company _____
 Former Title _____ Length of Time There _____
 New Company _____
 New Title _____ Date of Change _____

Any recent activity that would be of interest to members:

Stephen Carlouist, formerly superintendent, American Smelting and Refining Co., now is rocket engineer for Thiokol Chemical Corp., Brigham City, Utah.

J. E. Despina, for many years district manager in El Paso for Allis Chalmers Manufacturing Co., has been appointed sales manager for the company in Mexico, with headquarters in Mexico City.

John S. Carr is spending his sabbatical leave from the University of Melbourne, Australia, at the School of Mines, Columbia University. He is working with J. H. Schulman, the professor, on flotation research.

E. A. Krisher, III, formerly field engineer for Dravo Corp., will be opening a new office for Western Boiler Engineers Inc. in Sacramento, Calif., handling industrial boilers and burners, as sales engineer.

Jay A. Poll has resigned his position as assistant general manager, Nickel Processing Corp., Nicaro, Cuba, and has joined the International Nickel Co. He is in Copper Cliff, Ontario, Canada.

Frank B. Wolcott was vice president of Wyandotte Chemicals Corp. and has become executive vice president of Sawhill Tubular Products Inc.

Parry Barnes, who had been special representative for Caterpillar Tractor Co., is presently sales training manager in Benton Harbor, Mich., where the first series of distributor salesmen schools has just been completed.

F. L. McDonald, American Cyanamid Co., has transferred from Brewster, Fla. where he was assistant manager of phosphate operations, to Niagara Falls, Ont. He is now plant manager at Niagara for Cyanamid of Canada Ltd.

Ruperto G. Aguilar, owner-manager of Cia Minera La Amelia, S. A., now is director of Comision de Fomento Minero in Saltillo, Coah., Mexico.

John W. Lowry has been senior research engineer in the department of chemical research, Kaiser Aluminum & Chemical Corp. in Permanente, Calif. Now he is metallurgist for Food Machinery & Chemical Corp., in the mineral development department, Pocatello, Idaho.

Richard J. Claus, formerly geologist, Union Carbide Ore Co., is now managing director, Cia Desenvolvimento de Industrias Minerais, Rio de Janeiro, Brazil.

The formation of Aston Mineral Engineering Service, a consulting association, has been announced. Consultants are **Charles Aston**, petroleum geologist of Beverly Hills, Calif., and **R. Lee Aston**, mining engineer and geologist of Chattanooga, Tenn. **James Aston**, metallurgist, Pittsburgh, former Hunt gold medal-

ist, will have a limited association with the firm. Mineral Drilling Service of Chattanooga will change its name and offices will be maintained in Long Beach and Beverly Hills, Calif., Chattanooga, Tenn., and Tate, Ga.

R. G. Bergman has been working on an assignment to the government of Yugoslavia under USOM and through ICA as an expert on the selection, mining, and processing of chrome ores for the basic refractories industry. When he has completed this assignment he will do the same work in magnesite.

Frank M. Randall, general mill foreman for Cerro de Pasco Corp., spent 14 months working on the Mahr tunnel in Peru, and now is working on the Paragsha concentrator.

Gilbert L. Cox, formerly manager, Empire State Section, for The International Nickel Co. Inc., now is technical manager for Whitehead Metals Inc., Rochester, N. Y.

Oscar M. Davila came to the U. S. to work in a tin beneficiation research project sponsored both by the International Cooperation Administration and by Empresa Minera de Catavi in 1957. He did this investigation work in the Bureau of Mines, Rolla, Mo., and attended the School of Mines and Metallurgy of the University of Missouri. He finished the work and obtained an M. S. in metallurgical engineering, then returned to Catavi, Bolivia, to continue his work as general mill superintendent for Corporacion Minera de Bolivia.

Herbert Sommerlatte resigned as consulting mining engineer of the London & Scandinavian Metallurgical Co. Ltd., London, and has taken up the technical directorship with the Otavi Mining Co. Ltd. in Johannesburg, South Africa.

Harry E. Elber has been named general manager of the new Mining and Metals Div. of The Austin Co. **Gordon Galloway** has been promoted from assistant general sales manager to sales manager for mining and metals.



H. E. ELBER



G. GALLOWAY

Marion F. Bolton, who is manager of operations for Kerr-McGee Oil Industries Inc. at Shiprock, N. M., has been named general manager of operations for Kermac Nuclear Fuels Corp., Grants, N. M.

J. Carlton Ward, Jr., president of Vitro Corp. of America, has been elected chairman of the board of Heavy Minerals Co., Chattanooga, Tenn.

Walter K. Schelbe became vice president and general manager of the Liberia Mining Co. located in Monrovia, Liberia, West Africa, in January. Previous to this appointment he served as assistant manager.

Augustus B. Kinzel, vice president-research of Union Carbide Corp., was presented with the Stevens Inst. of Technology Powder Metallurgy Medal for his outstanding achievement in the field. Dr. Kinzel delivered the Medal Lecture Powder Metallurgy and the Microcosm.

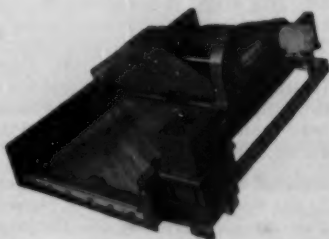
John Jeffrey Hanna, a former refinery manager with Imperial Oil Ltd., has been elected president of The Engineering Inst. of Canada for 1959-1960.

Clay Conference

(Continued from page 726)
mittee of the National Academy of Sciences-National Research Council.

Two symposiums will cover clay-water systems and clay mineral-geochemical prospecting methods. General sessions and a field trip to the Wichita Mountains are being considered for the rest of the program. For further details write: C. G. Dodd, chairman, Eighth National Clay Conference, University of Oklahoma, Norman, Okla.

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personals

continued

Charles K. Brown, geologist for Aluminum Co. of America, transferred from Bauxite, Ark. to the main office in Pittsburgh.

Robert E. Hayes, formerly general superintendent for Wilcox-Lilyama Mining Co., has been with Ingersoll-Rand Co. in the drill department and now has been transferred to their contract service department as sales engineer.

Harvey Stahl is employed as a graduate engineer with Allis-Chalmers Manufacturing Co. in Milwaukee.

George P. Lutjen has been appointed advertising sales manager of *American Metal Market*, the daily metal industry newspaper.

W. F. McDermott, Pickands Mather Co., has been transferred from the Hibbing laboratory where he was a metallurgist, to the Erie Mining Co., Pickands Mather's largest taconite operation in northern Minnesota, where he will be superintendent of process development.

Reserve Mining Co. also announced personnel changes. **Wayne E. Apuli** was advanced to the position of supervisor, Development and Control. **Carl W. Virant** became chief process engineer. And **H. A. Engman** was named chief chemist.

Erskine A. Massey, since 1954 assistant superintendent of International Minerals & Chemical Corp.'s phosphate mines at Bartow, Fla., has now been transferred to that company's mining and exploration department as a mining engineer, with headquarters in Skokie, Ill.

Three new district sales managers for Atlas Powder Co.'s explosives division have been named. **Stephen M. Wilson, Jr.**, formerly manager of the Joplin, Mo., district, has been named manager of the Eastern district with headquarters in Wilmington, Del. **M. A. McDuff**, who has been sales supervisor in the Houston, Texas, area of the Joplin district, was appointed manager at Joplin. **Walter R. Law**, formerly a special representative in the Chicago area, has been named manager of the Pittsburgh area.

Charles E. Bagwell has been elected to the board of directors of Hanson-Van Winkle-Munning Co. He joined the firm in 1956 as chief engineer and became vice president in charge of engineering in 1958 and in charge of the Equipment Div. in 1959.

The Aluminum Co. of America announced recent promotions including the appointment of **Frank L. Magee**, president, as chief executive officer of the company. Three vice presidents who were elevated to the rank of executive vice president are: **M. M. Anderson**, **Leon E. Hickman**, and **Lawrence L. Litchfield, Jr.** Newly elected to the post of vice president are: **T. W. Bossert** and **R. A. Learnard**.



R. LITCHFIELD, JR.



C. E. BAGWELL

Paul H. H. Lu, formerly mining engineer for Taiwan Provincial Department of Reconstruction, now is senior industrial specialist in geology and mining for the International Cooperation Administration MSM/China in Taiwan, Free China.

James A. Noble has resigned his position as professor of economic geology at the California Inst. of Technology. He will continue to live in Pasadena and carry on consulting work for a number of companies having interests in California, British Columbia, and Alaska.

Herbert Hoover Jr., has been elected to the finance committee of the Monsanto Chemical Co. He is an independent consulting engineer and has been a director of Monsanto since last December.

A. L. Lloyd has resigned as mine manager of Mary Kathleen Uranium Ltd. and has been appointed assistant general manager of the Thiess Snowy Mountain Project in New South Wales, Australia.

Sam S. Mele, metallurgist for The Booth Co. of Salt Lake City, left New York in April and spent a month working on minerals beneficiation, examinations, and development of a diamondiferous property in the State of Mato Grosso, Brazil.

Arthur E. Falvey has been transferred to the Chemstone Corp., dominion plant, in Strassburg, Va., as plant engineer by the parent firm, Minerals & Chemical Corp. of America, where he was process engineer in McIntyre, Ga.

Elliott F. Dressner, formerly geologist, International Minerals & Chemical Corp. in Winnetka, Ill., has become vice president of Walters Drilling Co. Inc., Dallas.

J. L. Kellogg, who was assistant manager of Stanleigh Uranium Mining Corp. Ltd. in Elliot Lake, Ont.,

now is mining engineer for Cerro de Pasco Corp., New York.

William D. Baker has resigned as general superintendent of the Parral Unit of American Smelting & Refining Co., at Parral, Chihuahua, Mexico. He is returning to the U. S. to enter the consulting business in mining. His temporary address is Box 235, Ajo, Ariz.

Robert M. Dreyer has resigned from Kaiser Aluminum and Chemical Corp. and has joined the geological staff of Reynolds Metals Co., Richmond, Va.

Douglas J. Crawford, formerly associated with Kermac Nuclear Fuels, now is a junior engineer for Phelps Dodge Corp., New Cornelia Branch, Ajo, Ariz.

E. T. Knight, general manager of Honduras operations for New York & Honduras Rosario Mining Co., has become vice president of Rosario Explorations Ltds., a subsidiary. He is located in Montreal.

Waldemar F. Dietrich of the U. S. Bureau of Mines, formerly chief of the Branch of Ceramic & Fertilizer Materials in Washington, D. C., now is chief of the Office of Mineral Resources, Region II, San Francisco. **Donald R. Irving**, formerly assistant chief, will replace Mr. Dietrich as acting chief in Washington.

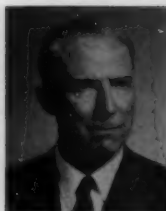


J. W. JOY

John W. Joy has been assigned as a safety products sales engineer in Indianapolis for Mine Safety Appliances Co., Pittsburgh. He has been in the Safety Products Marketing Services since 1957.

Lyman H. Hart, chief geologist of the American Smelting and Refining Co. for the last 13 years, has become consulting engineer for Guggenheim Brothers in charge of exploration for the firm.

Sathit Tandanand of Bangkok, Thailand, Visiting Research Scientist with the ICA program, has arrived at Pennsylvania State University for his doctoral studies in mining engineering. He received the visiting scientist award in competition with outstanding Thai scientists from many fields and is the recipient of a special grant from the National Academy of Sciences permitting him to pursue research and doctoral work at the university of his choice in this country.



L. H. HART

Wallis H. Crow, sales engineer for material handling equipment, has left the Denver office of Continental Gin Co. of Birmingham and is a field engineer for Hewitt-Robins Inc. with headquarters in San Francisco.

Dean R. Schnaible, formerly a student at the University of Oregon, now is assistant engineering geologist for the Dept. of Water Resources, State of California, with headquarters in Sacramento, Calif.

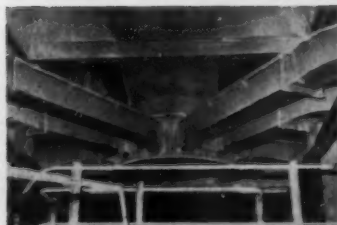
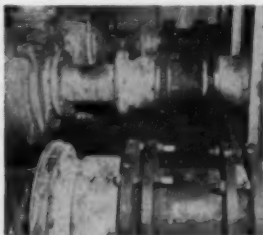
H. A. Lever, after 20 years of service with the State of Minnesota, for the last 15 as chief mining engineer, retired in December and will be at his vacation address in Britt, Minn., fishing this summer.

Ralph B. Utt, vice president and executive engineer of the Western Machinery Co. of San Francisco, was elected third vice president of the Manufacturer's Div. of the National Sand & Gravel Assn. at its annual meeting, February 16, in New Orleans.

James R. Garvey has been appointed by the Mining Development Committee of Bituminous Coal Research Inc. to the position of acting director of Development of the Bituminous Coal Research Mining program.

Harry A. Shaw has been appointed assistant to the general manager of the White Pine Copper Co., White

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1. View of Port pump well.
2. View of Linatex-lined distribution box and chutes.
3. View of cyclone underflow and discharge hopper.

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personals

continued

Pine, Mich. He has been associated with Kennecott Copper Corp. for over 20 years.

M. F. Goudge, of Ottawa, Canada, has been elected a director of American Nepheline Ltd., Toronto. He recently retired as chief of the Industrial Minerals Division of the Canadian Dept. of Mines at Ottawa, where he had served since 1923.

Robert B. Brackin, consultant, formerly with E. I. du Pont de Nemours & Co., now is with Kennecott Copper Corp., working in rare metals. His home is still in Wilmington, Del.

Ian D. Hendrickson has moved to the new Indio Merto black cave copper mine of the Andes Copper Mining Co. in northern Chile where he will be shift foreman. He had been mining engineer for Anaconda.

McFarland & Hullinger has taken over the old Bluebell mine at Mayer, Ariz., and transferred **R. H. Ashlock** to be superintendent there.

John J. Collins, special representative in Europe and Africa for American Smelting & Refining Co., now is general manager, mining department, of Revere Copper and Brass Inc., New York.

P. Wallenberg, formerly manager, compressor division of Atlas Copco Eastern Inc., in Paramus, N. J., has become managing director of Atlas Copco Rhodesia Pvt., Ltd. in Southern Rhodesia.

K. L. Allen, who was assistant superintendent for Cerro de Pasco Corp. for nine years, now is division mine superintendent for The Fresnillo Co., Fresnillo, Zac., Mexico.

Bituminous Coal Research Inc. has elected eight executives to their board of directors. The following new



Marcel Lecompte (center), young International Nickel Co. miner, shows the citation and Medal for Bravery awarded to him recently by the Canadian Inst. of Mining and Metallurgy to Nick Duda (right), whose life he saved in a dramatic incident at Inco's Levack mine. While Lecompte and his partner, Duda, were lighting a round of holes in the mine, one shot fired, knocking Duda unconscious. Lecompte recovered in time to carry Duda to safety seconds before the other blasts went off. He is twenty years old.

members were elected: **Eugene Gordon**, vice president, Western Power Co.; **S. B. Johnson, Jr.**, president of The Lorado Coal Mining Co.; **S. T. Saunders**, president, Norfolk and Western Railway Co.; **R. P. Tibolt**, executive vice president, Eastern Gas and Fuel Assoc.; and **W. L. Wearly**, president, Joy Manufacturing Co. Three members who were reelected are: **A. A. Potter**, president, Bituminous Coal Research Inc.; **R. L. Savage**, vice president, North American Coal Corp.; and **L. N. Thomas**, president, The Carbon Fuel Co.

Elections at the American Zinc Inst. included the office of president, given to **R. G. Kenly**, vice president of The New Jersey Zinc Co. Other officers elected included three vice presidents: **T. A. Campbell**, **H. D. Carus**, and **E. H. Snyder**. Reelected vice presidents were **G. H. LeFevre**

and **J. L. Kimberley**. The directors who were elected were: **V. C. Allen**, **Andrew Fletcher**, **C. R. Ince**, **F. R. Jeffrey**, **E. S. McGlone**, **J. S. Smart, Jr.**, **E. H. Synder**, **S. D. Strauss**, **Jean Vuillequez**, and **W. G. Woolf**.

J. Douglas Darby has been appointed vice president and assistant to the president of U. S. Steel Corp. He was an administrative vice president.

Appointment of **Henry E. Mahneke** as chemist was announced by SKF Industries Inc. Formerly he had been assistant manager, Eastern Research Div., for Rayonier Inc. His home is in Morristown, N. J.

John Wood Industries Ltd., Toronto, has elected **Howard I. Young**, who is president of American Zinc, Lead & Smelting Co., as a director. Also named to the board were **A. M. Alkman** who is president of the subsidiary, John Wood Co., and **Arch F. Jordan**, senior vice-president and general manager of the subsidiary's Bennett Pump Div.

Walter Wehtje has retired from his post of Chairman of the board of Atlas Copco AB, and has been succeeded by **Marcus Wallenberg**. **Nils Vult von Steyern** has been elected deputy chairman and **Marc Wallenberg, Jr.**, has become a member of the board.

Herbert E. Hirschland has been elected vice president in charge of commercial development of Metal & Thermit Corp. Previously he had the title of director of commercial development.

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Obituaries

Edgar Morgan Barker

An Appreciation By
Lewis A. Parsons

Edgar Morgan Barker (Member 1937), mining engineer and Portland cement executive, died unexpectedly in Honolulu on March 19. He was 50 years old.

Ed Barker, known to his social friends as Morgan, was born in Globe, Ariz., the son of Edgar E. Barker and Elizabeth Morgan Barker of Nevada City, Calif. He came by his mining aptitude naturally, as his father was a distinguished mining engineer who left his mark in many parts of the world.

Ed graduated from the University of Utah in 1931 with a B.S. in mining and metallurgy. His early career was unusually varied, which supplemented his inherently good judgment by experience that gave him a deep insight into many different kinds of people. His first job was as mine surveyor in the Transvaal, following which he was mining engineer for three years at the Roan Antelope mine in Northern Rhodesia. He then returned to this country, where he was research chemist for another three years for American Potash and Chemical Co. at Trona, Calif. But foreign lands called again, and in 1939 he became assistant plant superintendent for the Anglo-Chilean Nitrate Corp. in Chile. He served in that capacity for three years, and then returned again to the United States to become a department head for the Shell Chemical Co. at Pittsburgh, Calif.

In 1947 he was invited to join the staff of Calaveras Cement Co. as manager of the plant at Kentucky House near San Andreas, Calif. During the five years he held this position he established the pattern of expansion which eventually built Calaveras into one of the large cement plants in the West.

In 1953 he was brought to the head office of Calaveras in San Francisco as vice president in charge of operations, and there Ed Barker found his niche.

His faculty for rapid and accurate decisions, and his ability to implement them without time-consuming delay and controversy, was matched only by the love and loyalty he inspired in all who worked with him.

In addition to his duties as vice president of Calaveras, Ed was also president of Calco Supply Co., and a director of Stockton Building Materials Co., Standard Materials

Co., and four allied companies, all Calaveras subsidiaries, and of the Engineer's Club of San Francisco. He was a member of the San Francisco Rotary Club, the Commonwealth Club, and the Mining and Metallurgical Soc. of America.

Ed was keenly interested in Institute work. Never robust as the result of a childhood illness, he yet gave fully of his time and energy to the furtherance of Institute affairs. He served for two years as secretary-treasurer of the San Francisco Section, for one year as vice chairman, and was chairman of the Section in 1958. He was general chairman of the AIME National

Convention held in San Francisco in February, a responsibility to which he gave the maximum of effort. He was a large influence in obtaining San Francisco subscriptions for the new United Engineering Center in New York, a project that was close to his heart.

Ed was married in 1948 in Berkeley to Phyllis Kiesel. They had one son, Stephen K. Their home was at 8 Tappan Court, Orinda, a suburb of San Francisco in the East Bay hills.

Besides his driving energy, Ed's life was characterized by a basic integrity and by a love of people. He was a devoted family man, a charm-

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ing and generous host, and had an infectious sense of humor that was not at all averse to laughing at himself when the occasion arose. He was always a congenial and delightful companion, at work or at play. An enthusiastic fisherman, he took frequent trips with few friends into remote areas of the Sierra wilderness.

As others take over, the many activities on which Ed left his imprint will go on, a little better for the drive and enthusiasm that he had brought to them. But he is going to be keenly missed, and his untimely passing has left a gap that will be hard to fill. As his associate of many years, and as one of the many who loved him, I know.

A. C. Borgeson (Member 1942) died on Dec. 13, 1958. He received an E.M. degree from the School of Mines and Metallurgy, University of Minnesota, in his home state, and worked for most of his life near his birthplace of Chisholm, Minn. He began as resident engineer, Webb mine, at Hibbing, for the Shenango Furnace Co., and later became supervisor of Safety & Personnel for Snyder Mining Co. on the Mesabi Range properties. In 1941 he became chief mining engineer for his firm in Chisholm.

Charles Camself (Honorary Member 1924) died on Dec. 19, 1958. Born

at Fort Laird, Northwest Territories, in 1876, he received a B.A. from Manitoba University and did graduate work at Queens College, Massachusetts Institute of Technology, and Harvard, receiving three Doctor's degrees. He did considerable geological exploration in Canada's Northwest when the country was an unmapped wilderness and in 1920 was appointed commissioner and deputy minister of mines. He received the Gold Medal of the Institution of Mining and Metallurgy, among other honors and awards.

Charles W. Daniels (Member 1924), international representative of the Harnischfeger Corp. of Milwaukee, died Jan. 30, 1959. He was born in St. Louis in 1894 and was residing in New York at the time of his death.

Leo S. Hayes (Member 1935) an engineer for the American Smelting and Refining Co., died of a heart attack at his home on Jan. 31, 1959. He was a graduate of Massachusetts Inst. of Technology. He worked in Jerome, Ariz., in 1923 and 1924 and then spent 15 years on various assignments in South America. During the War he was with the OPA in Washington and was subsequently employed in the New York and Tucson offices of Asarco.

Charles A. Hirschberg (Member 1920) died in August 1958. He at-

tended Cleveland schools and Case Scientific where he majored in mechanical engineering. He began in Denver for Truax Manufacturing Co. and joined J. George Leyner Engineering Works Co., inventors and manufacturers of the hammer drill for rock work dry and wet patterns. He became publicity manager for Ingersoll-Rand Co. in New York, among other positions, and contributed to many trade magazines. In 1919 he was president of his own firm, Charles Austin Hirschberg Inc., technical advertising counselors. Later he was president of Howard H. Samuel Inc. in Hackettstown, N. J.

Floyd M. Jardine (Member 1917) passed away in Los Altos, Calif., Dec. 16, 1958. He had graduated from Colorado College in 1911 and worked as sub foreman, metallurgical engineer, and general mill foreman at Ray Consolidated Copper Co., Hayden, Ariz. In 1915 he was general mill foreman for Alaska Gastineau Mining Co. Other firms he worked for included Nevada Consolidated Copper Corp., Kennecott Copper Corp., and Round Mountain Gold Dredging Corp., all in Nevada. He later moved to San Francisco and then Los Altos.

Dorsey J. Parker (Member 1917) died Nov. 21, 1958. He had been born in Roberts, Ala., in 1877 and received a B.S. and C. E. from Alabama Polytechnic Inst. In 1911 and 1912 he did special work at Harvard University. During this time he worked for several mining companies, coal companies, and railroads. In 1912 he was general superintendent for American Coal Corp. He then joined the U. S. Bureau of Mines as safety engineer, working for them in Pittsburgh, Berkeley, Calif., Birmingham, and Salt Lake City for many years.

James H. Rasor (Member 1952) died Jan. 24, 1959. He was educated at Notre Dame University, the University of Southern California, Milton College, and St. Thomas College, where he graduated in 1930. From 1931 on he was chief clerk, refinery, for United States Potash Co. in Carlsbad, N. M.

David B. Reger (Member 1914) died Sept. 10, 1958. He received an A.B., and B.S. in civil engineering from West Virginia University while working for the U. S. Geological Survey, the U. S. Naval Station, and the West Virginia Geological Survey, where he returned to become assistant geologist, and acting state geologist in 1913. From 1919 on he did consulting geological work for commercial firms, the cities of Cleveland and Akron, and the U. S. War Dept.

Earle F. Snarr (Member 1945) died on Jan. 16, 1959. Born in Gardiner,

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Maine, in 1900, he attended Armour Inst. of Technology, Chicago Technology College, and the University of Wisconsin Extension. Since 1923 he had been working for Chicago, Wilmington & Franklin Coal Co., first as resident engineer, then as assistant superintendent, chief engineer, assistant to general superintendent, and in 1943, mine superintendent.

Harry E. Sparks (Member 1917) died on Dec. 25, 1958. Born in Grand Rapids, Mich., in 1891, he received B.S. and E.M. degrees from Michigan College of Mines. He started his career as a mining engineer for Calumet and Hecla Mining Co. and went to the Dome mines, Porcupine, Ont., as shift boss in 1916. He was superintendent over several operations, at the Croesus mine, the Tretheway mine, and Blue Diamond Coal mine, then from 1927 on he was manager of Oriole Mines Ltd. and a consulting engineer. Also for many years he was manager of O'Brien Gold Mines Ltd. in Kewagama, Que.

Eric E. G. Boyd (Member 1947) died on May 9, 1958. He was a native of New South Wales, Australia, and was educated at Scotch College and the University of Sidney, receiving his B.E. in mining and metallurgy in 1919. He gained general experience with Mt. Lyell M. & R. Co., Electrolytic Smelting and Refining Co., Zinc Corp. Ltd., and North Broken Hill Ltd. In 1923 he became assistant mill superintendent for Mount Morgan G. M. Co. Ltd. and a year later went to Malaya as general manager of Kuala Kampar Tinfields. From 1928 to 1946 he worked for Austral Malay Tin Ltd., as general manager and managing director, then became a consulting engineer.

Necrology

Date Elected	Name	Date of Death
1946	H. Raymond Banks	Feb. 4, 1959
1945	Stuart A. Falconer	Apr. 25, 1959
1951	Robert N. Freehling	Apr. 3, 1959
1946	Juan V. Hefferan	Apr. 24, 1959
1957	Lawrence Henderson	Apr. 24, 1959
1957	George T. Holland	Oct. 10, 1958
1954	Theo. Worley Legge	March, 1959
1959	Joseph S. Luckett	Mar. 30, 1959
1930	James S. Robbins	Dec. 7, 1958
1936	Loyal G. Tinkler	May 7, 1959
1918	Marvin J. Udy	Apr. 11, 1959
1940	W. D. Van Dyke, Jr.	Apr. 29, 1959
1953	Frank W. Woodman	Mar. 15, 1959
1918	Edward L. Young	May 6, 1959

Membership

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Total AIME membership on May 31, 1959, was 32,024; in addition 2,582 Student Members were enrolled.

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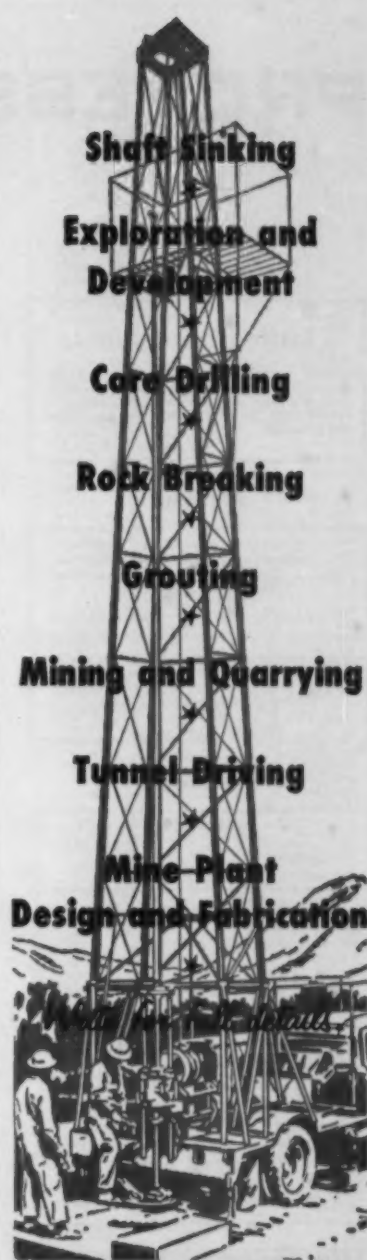
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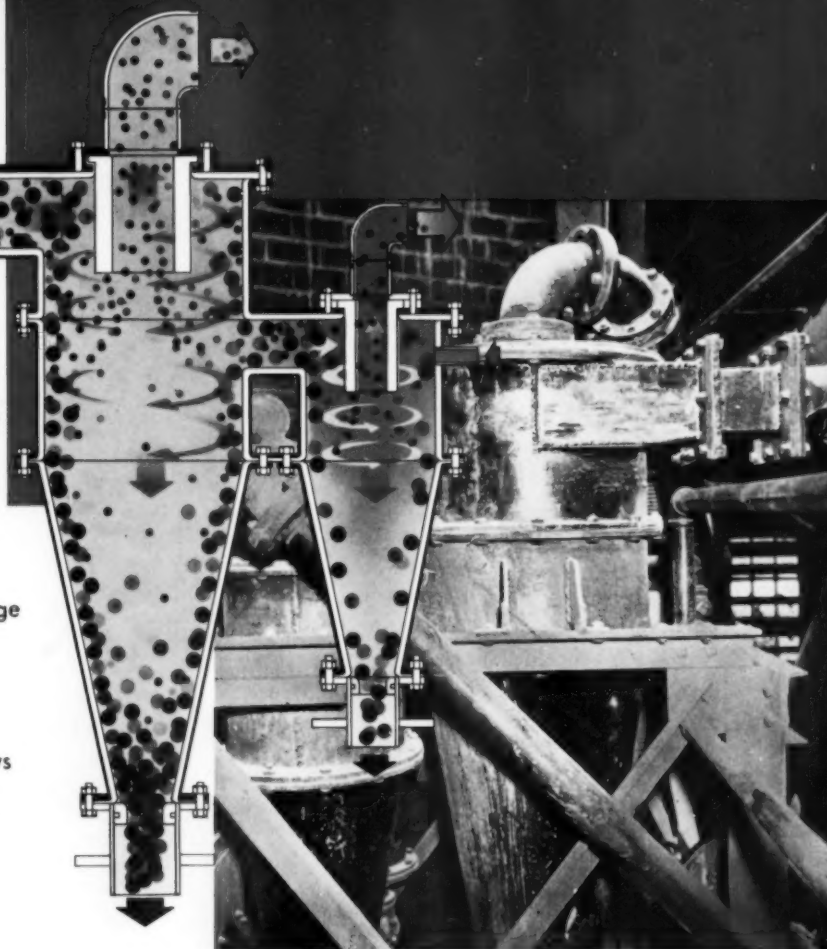
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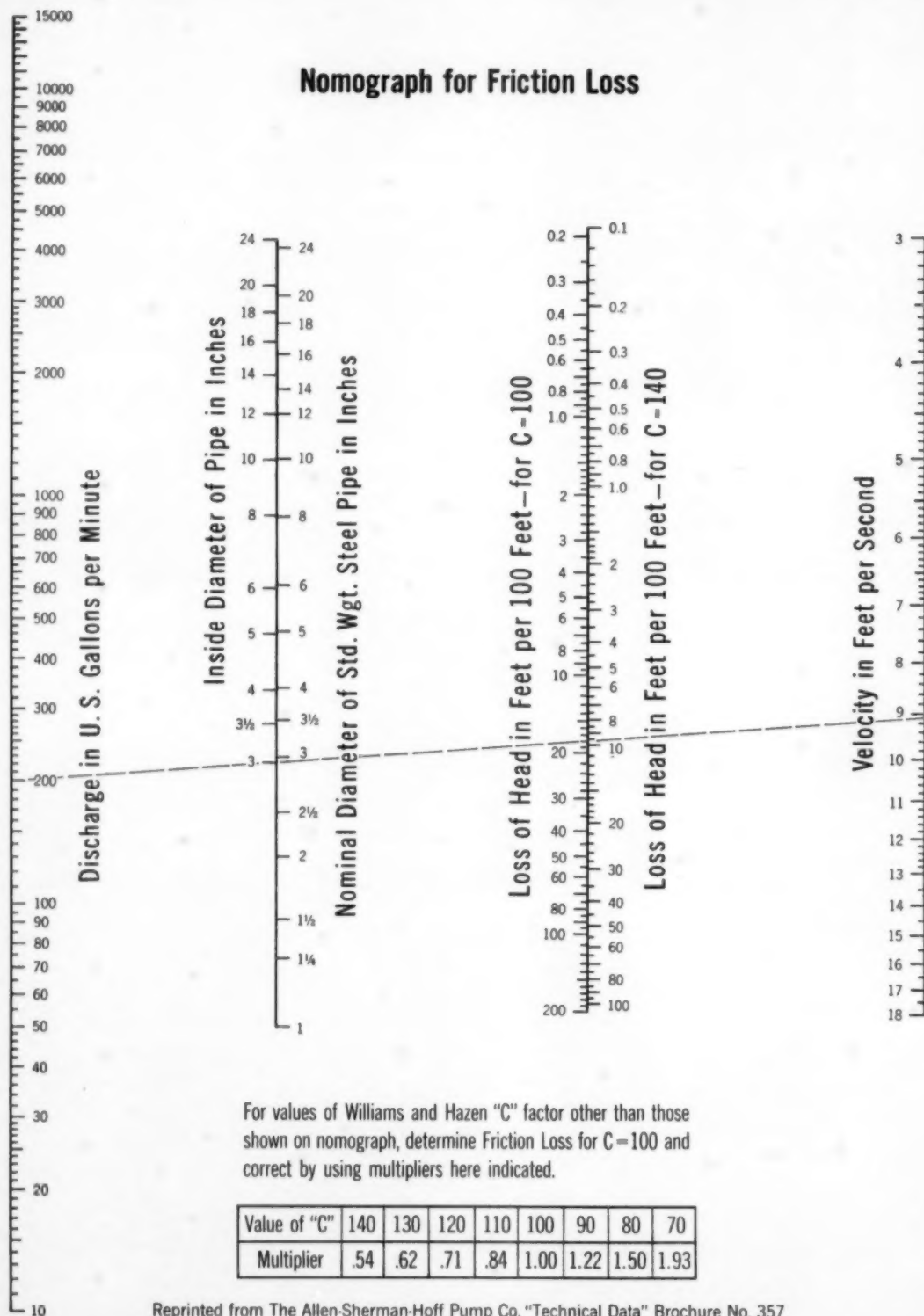
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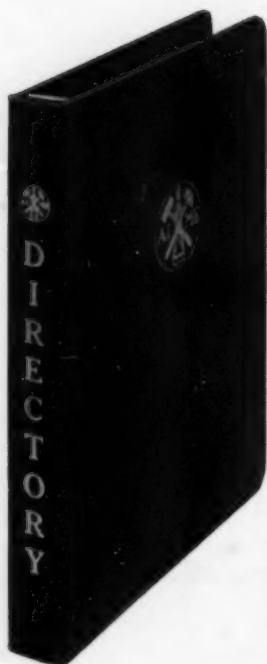
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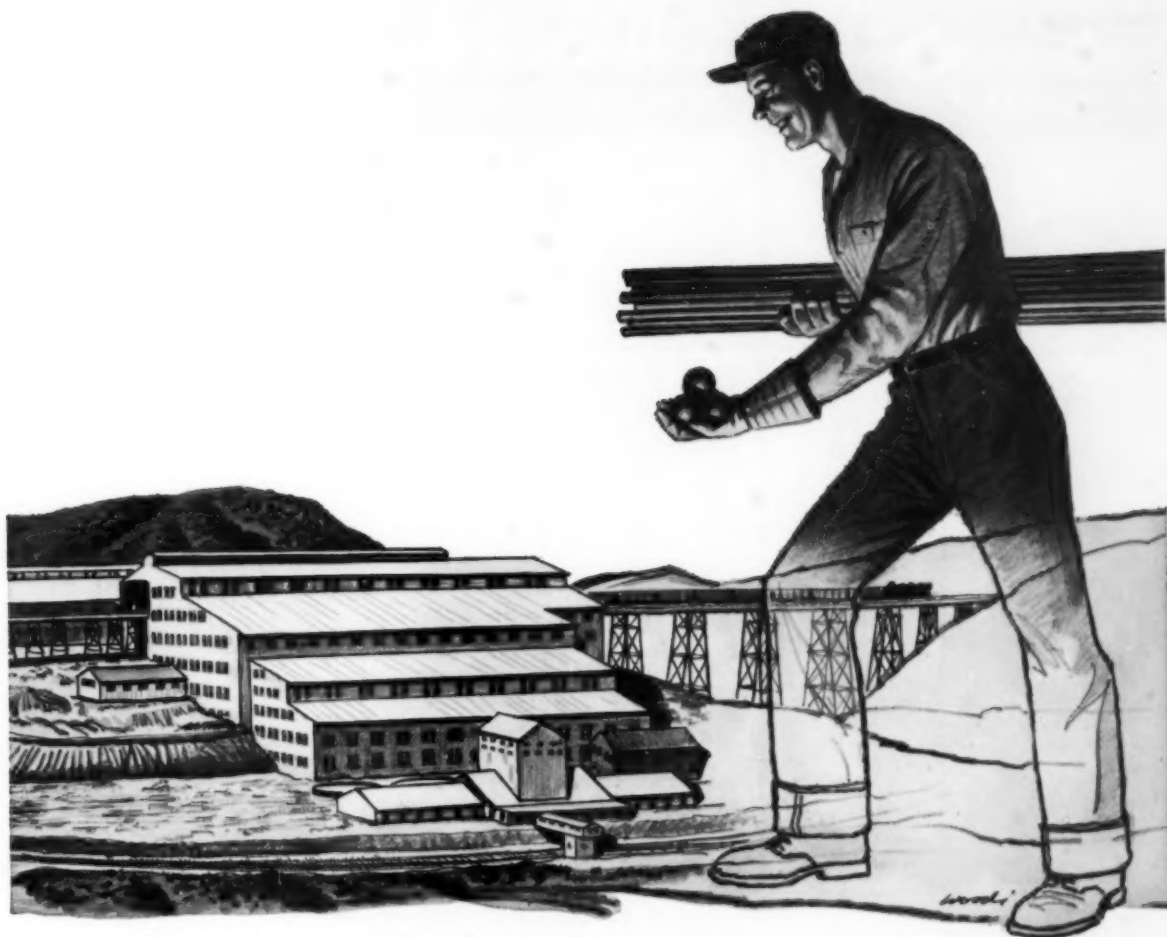
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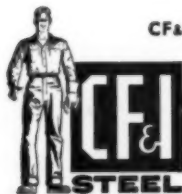
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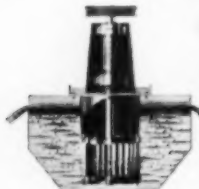









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	WEMCO AGITATOR- CONDITIONER	For fast, homogeneous agitating, mixing and blending. High intensity Fagergren type mixer-blender for reagents, other material with poor solubility characteristics. Propeller type available for conditioning flotation pulp, reagent mixing or blending. Certain parts interchangeable with Wemco Fagergren Machines. Turbine agitators also available for special applications.	Sizes: High intensity type cell sizes 2 cu. ft. to 100 cu. ft. Propeller type, tank sizes 2' to 20' diameter. Wearing Parts: Alloy iron, stainless rubber or neoprene covered.
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	WEMCO DIAPHRAGM PUMP	Widely used for handling dense pulp, sludges and other fluids with solids which wear or clog other pumps. Ideal for control of hydroseparator and thickener underflow. Adjustable speed and stroke. Fast takedown and replacement of parts.	Sizes: 2" to 4" Simplex & Duplex Capacity: 5 to 100 GPM Construction: Fine Grained iron, rubber valve seats, stainless steel or rubber covering.
	WEMCO SAND PUMP	Handles pulps of sands, abrasive solids, slimes, slurries and heavy media; pumps flotation feed, concentrates and tailings. Used for HMS circuits, screen products and grinding mill discharge to classifiers. Change of wearing parts made readily.	Sizes: 1 1/4" to 8" Capacity: 20 GPM to 2200 GPM Discharge Head: Up to 100 ft. Pulps Handled: Up to 65% solids, particles up to 1"
	WEMCO VERTICAL SAND PUMP	Provides performance of Wemco Sand pumps with added vertical application. Used for clean-up duty installed over sump or on cross members without need for separate dry pump pit. Can be mounted inside flotation concentrate launders for pumping concentrates.	Sizes: 1 1/4" to 4" Capacity: 20 GPM to 500 GPM Pulps Handled: Up to 65% solids, particles up to 3/4"
	WEMCO TORQUE-FLOW PUMP	New principle incorporates recessed impeller, continuous open passage. Permits pumping of large solids and tramp material in slurry without clogging. Wear is reduced since only small portion of slurry comes in contact with moving parts. Handles slurries with higher solids content than conventional pumps.	Sizes: 2"x2" and 3"x2" to 8"x8" and 10"x8" Capacity: 50 GPM to 2500 GPM Head: Up to 100 ft. Construction: NI hard for abrasive service.

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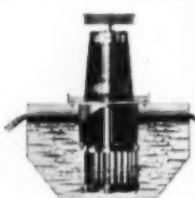







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EQUIPMENT	FEATURES	SPECIFICATIONS
	WEMCO MOBIL-MILL	Widely used for profitable production of marketable concentrates and low cost elimination of waste in treating metallic minerals, industrial minerals, coal and aggregate. Pre-engineered and pre-fabricated for maximum flexibility. Incorporates Wemco Drum type and Cone type separators for most accurate separations and highest recoveries.
	WEMCO FAGERGREN FLOTATION MACHINE	World standard of flotation in major operations with maximum capacity per cubic foot of floor space. Rotor-stator principle gives optimum pulp circulation and aeration for high metallurgical efficiency. New air control for increased cleaning efficiency. Special feed boxes eliminate costly pumping. Minimum adjustments.
	WEMCO SPIRAL CLASSIFIER	Slime-sand separations from 28 to 325 mesh. Single, double or triple spirals; tank options from straight side to full flare for desired settling area. Hydraulic lifting device available for starting under load without tank drainage. Sealed bearings, replaceable wearing shoes, continuous welded steel tube shaft assures long life.
	WEMCO REMER JIG	Ideal for concentration of large tonnages of ores where specific gravity differential exists and ratio of concentration is low. Provides exclusive differential acceleration — combined high and low frequency strokes — with live jig bed over entire surface.
	WEMCO AGITATOR-CONDITIONER	For fast, homogeneous agitating, mixing and blending. High intensity Fagergren type mixer-blender for reagents, other material with poor solubility characteristics. Propeller type available for conditioning flotation pulp, reagent mixing or blending. Certain parts interchangeable with Wemco Fagergren Machines. Turbine agitators also available for special applications.
WEMCO PUMPS		
	WEMCO DIAPHRAGM PUMP	Widely used for handling dense pulp, sludges and other fluids with solids which wear or clog other pumps. Ideal for control of hydroseparator and thickener underflow. Adjustable speed and stroke. Fast takedown and replacement of parts.
	WEMCO SAND PUMP	Handles pulps of sands, abrasive solids, slimes, slurries and heavy media; pumps flotation feed, concentrates and tailings. Used for HMS circuits, screen products and grinding mill discharge to classifiers. Change of wearing parts made readily.
	WEMCO VERTICAL SAND PUMP	Provides performance of Wemco Sand pumps with added vertical application. Used for clean-up duty installed over sump or on cross members without need for separate dry pump pit. Can be mounted inside flotation concentrate launders for pumping concentrates.
	WEMCO TORQUE-FLOW PUMP	New principle incorporates recessed impeller, continuous open passage. Permits pumping of large solids and tramp material in slurry without clogging. Wear is reduced since only small portion of slurry comes in contact with moving parts. Handles slurries with higher solids content than conventional pumps.

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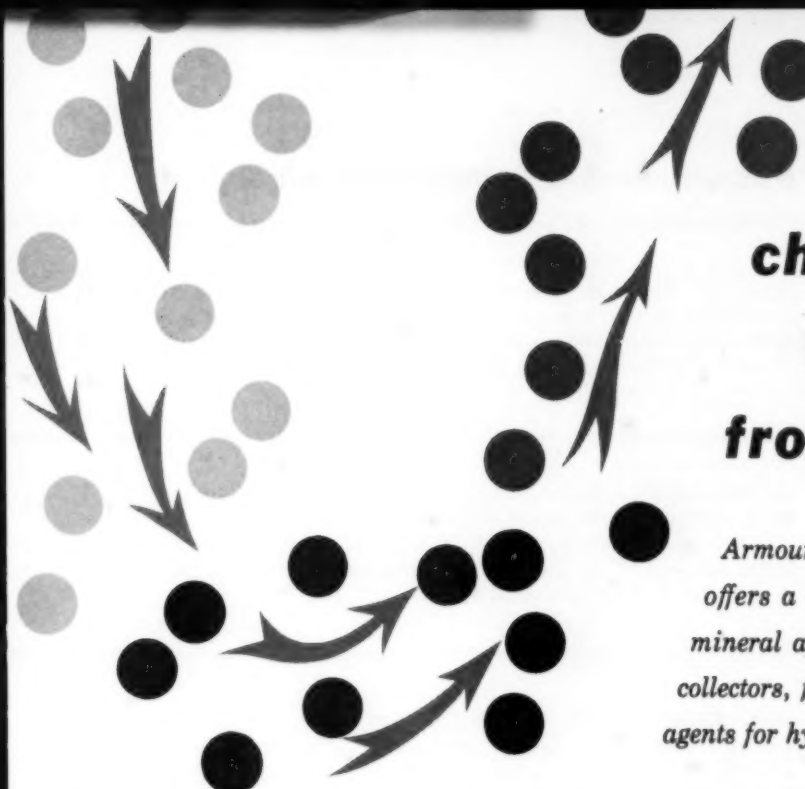
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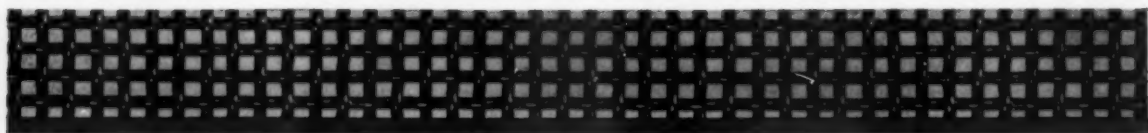
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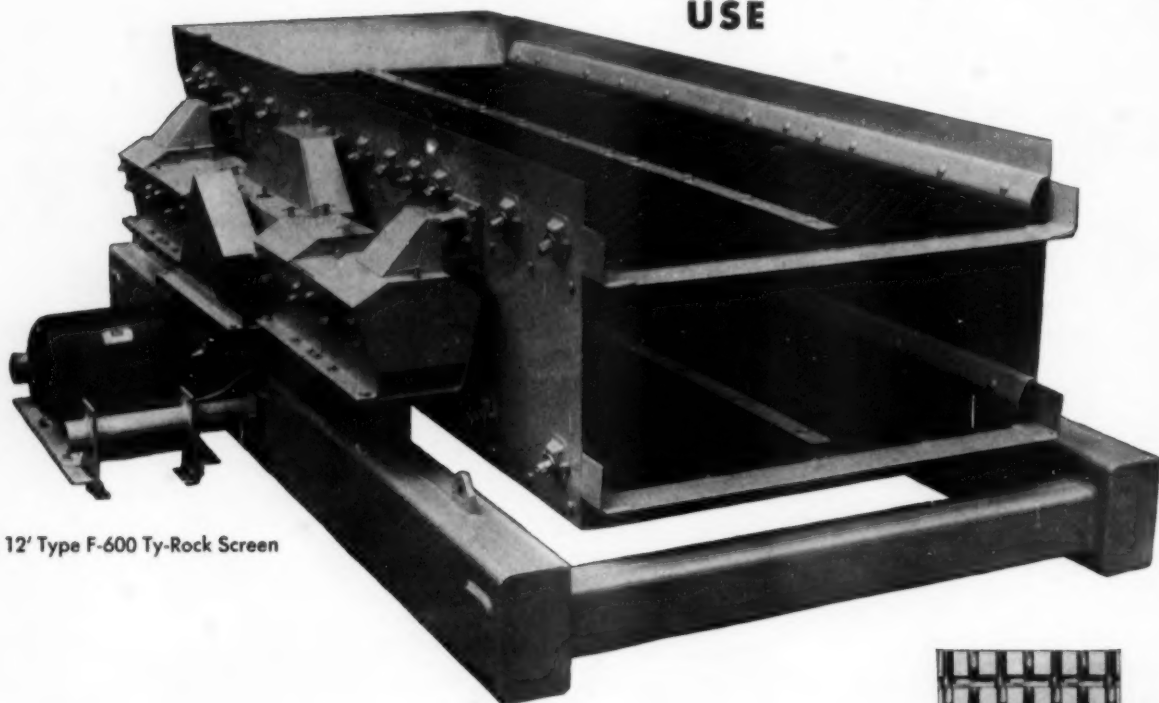
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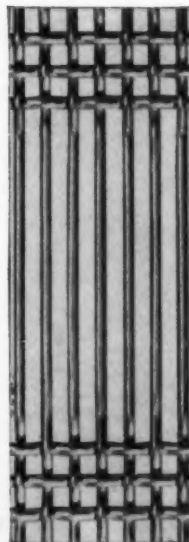
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Meade, Roy
*Miller, Grover C.
Pagel, Herbert E.
Perry, Morton H.
Pitmon, Guy R.
Powell, W. O., Jr.
Reed, Eugene F.
Sides, Judson B.
Smith, Walton F.
Temple, Robert A.
Tipper, John P.
Turner, William H.
Winerdorn, J. S.
Witt, Archie H., Sr.

CRAIG A.F.B.

No Data Supplied
Brown, David I.

DOCENA

No Data Supplied
Franklin, Carl P.

FAIRFIELD

T. C. I. R. R. Co.
Hayes, Willie
U. S. Steel Co.—TCI Div.
Allen, John D.
Armstrong, Charles H., Jr.
Blair, Harrison W.
Burdette, Robert E.
*Burge, H. Stanley, Jr.
Burke, Boles, Jr.
Cahill, George E.
Carnes, Donald
*Cofield, William H.
Crawford, Henry N.
Creveling, J. G.
Crumpton, Russian P.
Dietz, Robert A.
Filer, Alvin V., Jr.
Files, Edgar J.
Gegg, Edgar J.
Glasgow, Walter H., Jr.
Griffin, J. M.
Hiser, E. R.
Hodges, C. M.
*Holloway, Claude L., Jr.
Huey, J. Leonard
Johnson, Richard Bee
Kinnear, James W., Jr.
Kirkwood, Walter R.
*Laborde, R. J.
Lambert, Chris A., Jr.
Love, Louis L.
McCollar, Barney S.
McKenzie, Wm. C.
Messina, Paul J.
Moore, August A.
Moore, Melvin Carl
Morris, James C.

Myers, W. H.
Neal, George M.
Neason, James E.
Newton, Ed C., Jr.
Palestini, L. A., Jr.
Pourciau, J. L.
Roberts, Gordon L.
Salter, Marvin L.
*Schlick, J. R.
*Scott, J. Watts
Shaffer, Chas. E., Sr.
Sides, Glenn H.
Springer, W. S.
Thomas, Ester L., Jr.
Travis, Dan F.
Waldrop, Thomas L.
Weed, Jas. K.
White, Richard S.
Wickstrom, Walter W.
Wiggins, Carl
No Data Supplied
Copeland, Billy D.
Herren, Elijah O.
Ray, Charles W.
Roberts, S. Jay
Towers, Ralph
Saunders, Archie O.

FLAT TOP

U. S. Pipe & Fdy. Co.
Cassidy, Percy M.

FT. MC CLELLAN

*Jones, Stuart M., Jr.

GARDENDALE

No Data Supplied
Malone, Floyd R.

GORGAS

Alabama Power Co.
Boggs, D. L., Jr.
Harsany, John
Henderson, Lawrence
*Hutchings, T. E.
Wilson, William G.

HEFLIN

Dixie Mines Inc.
Bailey, Joe W.
No Data Supplied
Loudmilk, E. L.

HOMEWOOD

No Data Supplied
Culwell, F. B.

HUEYTOWN

No Data Supplied
Herren, Clarence E.

HUNTSVILLE

Brown Engr. Co. Inc.
*Donnini, James M.
Redstone Arsenal
*Pierce, Bruce
Swenson, Gerald R.
No Data Supplied
Zarzarvatjan, P. A.

JASPER

Bankhead Mimeo Co. Inc.
*Cobb, W. Frank, Jr.
No Data Supplied
Caskie, Hamilton B.

LEEDS

Univ. Atlas Cement Co.—U.S.S.
Kackman, Arnold H.

LIPSCOMB

No Data Supplied
Zukow, Peter J.

MOBILE

Gulf Mobile & Ohio R. R.
*Riggs, William A.

MT. BROOK

No Data Supplied
Kerley, Henry E.

ONEONTA

Robbins Coal Co.
Tidmore, Erskine

PARRISH

Ala. By-Prod. Corp.
Breland, James E.

SHEFFIELD

T.V.A.
Davenport, John E.
No Data Supplied
Cole, Richard E.

TARRANT

Ala. By-Prod. Corp.
Mobley, Willard M.

TUSCALOOSA

Twin Seam Min. Co.
Shook, George A.
No Data Supplied
*Gandrud, B. W.

UNIVERSITY

Geological Survey of Alabama
Jones, Walter B.
Fallister, Hugh D.
U. S. Bureau of Mines
Browning, James S.
Clemmons, B. H.
U. S. Geol. Survey
Simpson, Thomas A.
Univ. of Alabama
*Ahrenholz, H. Wm.
*Cudworth, James R.
*Shotts, Reynold O.
U. S. Steel Corp.—TCI Div.
Miller, Herbert E.
No Data Supplied
Alford, James T.
Clements, L. W., Jr.
Siebert, Harry L.

WOODWARD

Woodward Iron Co.
Foust, D. T., Jr.
Hager, John W.
Kirk, Thos. H.
Sullivan, S. E.

ALASKA

ANCHORAGE

Alaska Dept. of Mines
Jasper, Martin W.
*Robinson, Wiley D.
Alaska Mineral Consultants
*Kalmbach, G. F.
Bureau of Land Mgmt.
*Burgess, Dwight S.
Bureau of Mines
Johnson, Kenneth A.
The Carrington Co.
Gustafson, G. A.
CEMCO Inc.
*Beckwith, H. Rea
Elmendorf AFB
*Attwood, William F.
Erickson Placer Equipment
*Erickson, Walter A.
Evan Jones Coal Co.
Hill, Donald K.
Federal Aviation Agcy.
Parent, Armand
Oil Well Supply & Service Co.
*Ryan, John E.
Reeve Aleutian Airways Ins.
*Reeve, Robert C.
Strandberg & Sons
Strandberg, Edw. O.
Strandberg, Harold
Strandberg, Wm. J.
Suntranda Mining Co.
Kirkpatrick, M. B.
Ledbetter, C. A.
U. S. Army Engineers
Waugh, Rogers V.
U. S. Geological Survey
Saarela, Leo H.
Western Drilling & Equip. Co.
Gunnarson, LeRoy
Yukon Equipment Inc.
Chambers, Glen D.
Zaegel Exploration Co.
*Zaegel, William G.
No Data Supplied
Bachner, John G.
Bachner, Karl A.
Bagoy, John P.
Boyd, Robert J.
Dodd, Edward N.
Faroe, H. A.
Hill, Harry J.
Kreitlow, Edwin J.
Mathews, R. T.
Neubauer, Jack
*O'Neill, William A.
Stanley, Kirk W.
Swalling, A. C.
Wolfe, Ray G.

CEMCO Inc.

U. S. Army Engineers
Waugh, Rogers V.
U. S. Geological Survey
Saarela, Leo H.
Western Drilling & Equip. Co.
Gunnarson, LeRoy
Yukon Equipment Inc.
Chambers, Glen D.
Zaegel Exploration Co.
*Zaegel, William G.
No Data Supplied
Bachner, John G.
Bachner, Karl A.
Bagoy, John P.
Boyd, Robert J.
Dodd, Edward N.
Faroe, H. A.
Hill, Harry J.
Kreitlow, Edwin J.
Mathews, R. T.
Neubauer, Jack
*O'Neill, William A.
Stanley, Kirk W.
Swalling, A. C.
Wolfe, Ray G.

COLLEGE

Univ. of Alaska
*Anthony, Leo Mark
*Beistline, Earl H.
Hoskins, J. R.

Alabama-Alaska

*Huber, Douglas W.
Hunter, Lorne H.
Patty, Ernest N.
*Sandvik, Peter O.
No Data Supplied
Bloom, George C.
Coonjohn, Edwin J.
Hock, Jerry L.
Mitchell, Irwin W.
Poborski, S. J.
Reed, Jack C.
Rolf, Walter H.
Sagmoen, Donald P.
Stein, D.

CORDOVA

No Data Supplied
Collins, Clifford P.

ESKA

No Data Supplied
Tucker, Robt. Lester

FAIRBANKS

Alaska Nickel Co. Inc.
Parker, Ace R.
Bureau of Land Management
Schmidt, George R.
Chandler Mining Co.
*Matheson, Hugh J.
Cripple Creek Coal Co.
Shallit, A. Ben
Exploration Services Inc.
*Colp, Douglas B.
North American Min. Co.
*James, Yancy L.
Merl F. Thomas Son, Inc.
Thomas, Merl F., Jr.
U. S. Smelt & Ref. Co.
Boswell, John C.
Usibelli Coal Corp.
*Bread, Denny G.
Waugaman, Wm. I.
Yukon Equipment Inc.
Lomen, Alfred J.
No Data Supplied
Anderson, Kenneth P.
Butler, Maurice
Crawford, James D.
*Herbert, Charles F.
Lofus, T. A.
MacDonald, D., III
Mathews, Ted C.
Ringstad, Mark B.
Saunders, Robert H.
Soboleff, Simon M.
Thomas, Bruce I.

JUNEAU

Alaska Dept. of Mines
Holdsworth, Phil R.
Williams, James A.
U. S. Bureau of Mines
Berryhill, Robert V.
Herdlick, Jared A.
Maloney, Raymond P.
Pittman, Tom L.
Thorne, Robert L.
U. S. Forest Service
Banta, Howard E.
No Data Supplied
Mihelich, M.
Moon, John E., Jr.
Pekovich, W. S.

KETCHIKAN

No Data Supplied
*Lorain, S. H.

NOME

Alaska Dept. of Mines
Burand, Willow M.

NYAC

No Data Supplied
Race, William H.

FALMER

No Data Supplied
Hulbert, James H.

RED DEVIL

No Data Supplied
Holloway, Dorr
Lyman, Robert F.

SITKA

Edgcombe Exploration Co.
Morgan, Glenn H.

SKAGWAY

No Data Supplied
Tunley, A. T.

Alaska-Arizona

SOLDATNA

No Data Supplied
Corr, Tommy

SPENARD

No Data Supplied
Andersen, Burton L.
Park, Howard M.
Wilcox, Donald G.

SUNTRANA

Cripple Creek Coal Co.
Cinkovich, Thomas L.

SUTTON

Mrak Coal Co.
Moor, Julius H.
Mrak, William

TALKEETNA

No Data Supplied
Powell, William S.

USIBELLI

Usibelli Coal Mine Inc.
Usibelli, Emil

WISEMAN

No Data Supplied
Leonard, Harry B.

ARIZONA

AJO

Phelps Dodge Corp.
Barr, Alfred T.
Briggs, James A.
Caton, Warren D.
Coppo, John E.
Cousens, Thomas R.
Crawford, Douglas J.
Denny, Frank W.
Fullagar, Arthur R.
Gensman, Owen A.
Herdon, Thomas R.
Hoppe, Harry M., Jr.
Hunter, Wm. C.
Keener, William
Littrell, Jim A.
Lyons, Alex H.
O'Neill, John E.
Rhoades, Richard E.
Richard, Forrest R.
Sullivan, W. T.
Thomas, William J.
West, Robert E.
Wyatt, John H.
Yentzer, W. C.
No Data Supplied
Cratty, Donald B.
Gardner, John D.
Glenn, R. E.
Hall, K. R.
Hickman, D. M.
Higgins, Blaine
Hinton, Troy B.
Jones, S.
Lewis, E. G.
Page, Theodore
Price, Walter L.
Seaberg, Fanez T.
Smith, James C.
Sparkman, W. T.
Wood, Morris S.
Young, Joe B.

BAGDAD

Bagdad Copper Corp.
Bogart, Robert C.
Guest, Gaylen
Jones, E. L., III
Webb, Rockwell L.
Cyprus Mines
Sierakowski, Joe O.
Sundeen, C. R.
Yundt, L. D.

BENSON

Apache Powder Co.
Crawford, Howard Dean
Towle, Louis W.

BISBEE

Goar Service & Supply
*Goar, Wm.
Phelps Dodge Corp.
Chandler, Dwight L.
Clark, Henry D., Jr.
Crowley, James S.
Dahlke, Gustav A.
Durrenberger, Joseph W.
Himebaugh, Arthur E.
Hogue, William G.

Holmes, Stanley C.
Kolesar, Joseph, Jr.
Ladd, J. H.
Larsen, J. Urban
Little, William W.
*Millaps, Frank W.
Phillips, Fred L.
Pincock, W. K.
Pollman, William F.
Sellers, J. K.
*Torgensen, Edward H.
Wenner, Conrad A.
No Data Supplied
Riddell, Richard D.
Travis, George E.

CLARKDALE

Phoenix Cement Co.
Johnson, Howard R.

CLIFTON

No Data Supplied
Berry, Tom W.
Willis, O. B.

CONGRESS

U. S. Tungsten Corp.
*Zannaras, John P.

DOUGLAS

Phelps Dodge Corp.
Davis, John H., Jr.
Fenzi, Warren E.
Geshell, Peter S.
*Klein, Leonard
Lawson, Walter C.
Ludden, Robert B.
Mailott, Elmer E.
McMillan, Donald T.
Miller, Charles P.
Fullen, J. B.
*Sumner, John S.
No Data Supplied
Allen, William, Jr.
*Davis, Leverett
Lewis, Herbert C.
McGuire, C. E.
Uren, William J.
Van Etten, George A.

FLAGSTAFF

Domino Mining Co.
*Ellis, Thomas J.
No Data Supplied
Riley, Thomas H.

GLENDALE

Moyer Enterprises
*Moyer, Darl A.

GLOBE

American Fiber Corp.
*Pyrah, D. A.
Mine Supply & Hdwe. Co.
Sullivan, William A.
U. S. Geological Survey
Peterson, Nels P.
No Data Supplied
Bamero, Ralph V.
Gilles, Albert P., Jr.
Pearce, Milton

GRAND CANYON

Western Gold & Uran. Inc.
Kofford, Max E.

HAYDEN

Am. Smelt. & Ref. Co.
Downey, Frank J.
Kennecott Copper Corp.
Allen, George J.
Bradford, Charles B.
*Conwell, Cleland N.
McAneny, Colin C.
Sewell, George P., Jr.
Stocker, James E.
*Vlasak, William Michael

HEREFORD

No Data Supplied
Cooper, John A.
Cox, Howard D.
*Dentzer, Edward G.
Galbiati, D. V.
Henry, Joe A.
Mulholland, L. E.
Woods, Robt. G.

HOUCK

Ariz. Silica Sand Co.
*Crawford, Wm. P.

HUMBOLDT

Shattuck Denn Mining Corp.
Apperson, Claude H.
Jeffers, Alba W.
Waples, Bee R., Jr.

INSPIRATION

Inspiration Cons. Copper Co.
Bilson, Thomas E.
*Brick, Carl W.
Carne, James L.
Cronin, John Ahearn
Honeyman, Pharis D. I.
Johnson, David W.
Lundy, James H., Jr.
*Mathewson, Donald E.
Mellus, Herbert H.
Moran, Lawrence K.
*Mugrove, Paul M., Jr.
Nilsen, John N.
Power, Kenneth L.
Reed, E. F.
Rice, Fred D., Jr.
Schrader, William D.
Sonstokke, Harold W.
Stunz, Carl G.
Theiler, John J.
Thomson, Norman G.
Watts, J. B.
Weed, H. Carroll
*Whitney, Bruce B.
No Data Supplied
Anderson, T. M.
Olmstead, Hugh W.

JEROME

Big Hole Mining Co.
*Gemmill, Mark
Phelps Dodge Corp.
*Reber, Louis E., Jr.
No Data Supplied
Gemmill, Richard H.

KAYENTA

Gibralter Minerals Co.
Rohlfis, Otto D., Jr.

KINGMAN

No Data Supplied
Charles, B. E.

LOWELL

Phelps Dodge Corp.
Niemi, Alfred E.
No Data Supplied
Gedge, George
Rounds, Elbert E.

MESA

No Data Supplied
*McCarthy, Donald P.
Smith, Lewis A.

MIAMI

International Smelt. & Ref. Co.
Coles, H. O.
*Foard, Harold
Maryott's
Maryott, Harold D.
Miami Copper Co.
Bean, James J.
Coil, B. R.
*Fletcher, James B.
Fowells, Joseph E.
Gray, John H.
Henderson, Thomas D.
Hughes, Robert P.
Napp, G. E.
Simmons, W. W.
Sloan, William F.
Spencer, John J.
Stover, Maynard M.
*Williams, E. G.
No Data Supplied
Allan, James W.
Henderson, T. D., Jr.

MORENCI

Phelps Dodge Corp.
Abell, Leo M.
Alexander, A. L.
Armstrong, James L.
*Austin, E. A.
*Bacon, Vance N.
*Bale, Richard P.
Barker, Lyle M.
Barr, Richard C.
*Berra, Felix G.
Bonine, Norman C.
Broderick, A. J.
*Crosa, Richard R.
Ennis, Jerry R.
Enrico, Tony
*Fitzgerald, Michael J.
Griffith, William A.
*Harbison, L. E.

Haxby, Ronald L.
Jacoby, Dwight C.
Lentz, John A., Jr.
Lines, Herbert L.
Mann, Robert E.
McWilliams, Thomas D.
Moolick, Richard T.
Orr, David H., Jr.
Scheier, Paul R.
Sorvisto, Charles
Stanley, Joe B.
Stock, John
*Urbard, Howard T.
Waters, Louis H.
No Data Supplied
Aker, Robert R.
Allen, Phil
Andrews, Floyd J.
Bishop, Andrew M.
Brooks, Wesley
Campbell, John R.
Conger, William C.
Doerges, R. F., Jr.
Hughes, Martin
Lines, Billy F.
McFarland, J. R., Sr.
McLean, L. D.
Olson, Lester D.
O'Neill, G. H.
Ormsby, Lawrence
Pettibone, M.
Richards, Wm. T.
Riley, Chleo C.
Tysseling, J. T.
Windrow, Tony M.

NACO

Cananea Consolidated Copper Co.
Ashe, Michael J.
Donohoe, C. P.
Humphrey, Wm. A.
Loving, John C.
Greene Cananea Copper Co.
*Ruggles, Guy H.
No Data Supplied
Corcker, Kenneth R.
Wells, James T.

NOGALES

Minas De Guatamo S.A.
*Lynch, H. Grattan
No Data Supplied
*Harcourt, Milo M.

ORACLE

No Data Supplied
Nichols, Henry W.
Woodruff, Frank C.

PATAGONIA

Lenon Engr. Office
*Lenon, Robert

PHOENIX

Allis Chalmers Mfg. Co.
Kinnon, William C.
Arizona Dept. Mineral Resources
Flagg, Arthur L.
Johnson, Axel L.
Knight, Frank P.
Lane, Travis, P.
Tuck, Frank J.
Arizona Highway Dept.
*Kimler, Courtney W.
Arizona Small Mine Operators Assoc.
Willis, Charles F.
Arizona Wholesale Supply Co.
*Miller, Alden W.
Barrett Haentjens & Co.
Dodge, Ralph O.
Braun Chemical Co.
Whittemore, Ralph C.
Boyles Bros. Drilling Co.
*Roberts, J. E.
Carlota Copper Co.
*Alexander, John L.
Colorado Fuel & Iron Corp.
Helms, Luther S., Jr.
KW-Dart
*Hyde, Harold H.
Evans, Kitchel & Jenckes
Kitchel, Denison
General Electric Co.
Blair, Robert R.
Harnischfeger Corp.
Taylor, John H., Jr.
Philip S. Hoyt & Son
*Hoyt, Philip S.
Isbell Construction Co.
DuPont, John Louis
Ward, John, Jr.
Marion Power Shovel Co.
*Johnsen, E. R.
Min-A-Con Equip. Co.
Mastin, John B.
Minneapolis Honeywell
*Agee, Jack C.

National Equipment Co.
Hoag, Leslie F.
National Malleable & Steel Casts. Co.
*Thomas, John F.
Peat, Marwick, Mitchell & Co.
*Fagerberg, Dixon, Jr.
Phelps Dodge Corp.
*Kuzell, Charles R.
Tognoni, Parsons, Birchett & Gooding
*Tognoni, Hale C.
U. S. Bureau of Mines
Harmon, John P.
John Allen Ware & Assoc.
Ware, John A., Jr.
No Data Supplied
*Alenius, E. M. J.
Beckett, T. G.
Brucker, Frederic L.
*Cody, Ben. H.
*Dunning, Charles H.
Engelder, Oscar G.
Fielding, Vernon E.
Fletcher, Frank X.
Foster, George K.
*Godfrey, Ralph G.
Haentjens, R. P.
Isbell, R. S.
*Lichty, Lyall J.
*Luke, Russell P.
Michels, E. M.
Mills, Robt. C.
Moeller, J. Edwin
Morgan, Edw. A.
O'Connell, Charles J.
Pardee, Jack Mc K.
*Rice, Neil A.
Smith, James O.
*Strutzel, J. J., Jr.
Swartz, T. C.
*Tamplyn, William Ward
*Tucker, Lee E.
Twitty, H. A.
Utermohle, G. E., Jr.
Yanez, James A.

PRESCOTT

Shattuck Denn Mining Corp.
Kentro, Dan M.
Still & Still Consulting
*Still, J. W.
*Still, Arthur R.
Tarr, McComb & Ware Comm.
Ware, John Allen
No Data Supplied
*Sherburne, Brown
*Gibbs, Fred
*Lintz, Mark
*MacLeod, Lester R.
Tomkinson, Elmer R.

RAY

Kennecott Copper Corp.
Ballmer, Ray W.
Bishop, Harold W.
*Bowman, Jack A.
Caviness, Clyde R.
Cirous, Robert O.
Grigby, Harry G.
Hood, John M.
Hoyt, C. LeRoy
Johnsen, S. F.
Lefler, C. Arthur
Metz, Robert A.
Miller, Leonard J.
Morris, Abe P.
O'Carroll, H. J.
Patton, John F.
*Sargent, Fred R.
Simpson, Donald L.
Taylor, C. W.
Van De Water, J. C.
*Wilson, Glen B.
No Data Supplied
Chambers, John R.
Coleman, Francis T.
Dickerson, A. L.
Dunn, Richard L.
Marksbury, D. L.
Vance, C. Kenneth
Willoughby, Robt. A.
Winkle, Robert F.

RILLITO

Arizona Portland Cement Co.
Chiaro, Dominic A.
Pierce, O. F.

SAFFORD

No Data Supplied
Tomkinson, Joe A.

SAHUARITA

Sunrise Mining Co.
*Irvin, G. W.

ST. DAVID

Lewisohn Copper Corp.
Hendricks, Howard R.

SAN MANUEL

San Manuel Copper Corp.

*Acton, Leslie C.
Buchanan, John F.
Buchella, F. H.
Burke, H. E.
Cigliana, Charles F.
Coolbaugh, M. J.
Coxon, Vincent I.
Crenshaw, A. H.
Given, Edmond V.
Goodwin, James W.
Goss, John W.
Heald, David D.
Jacobson, Max B.
Leaming, George F.
Matthews, Gilbert J.
Murray, Joseph W.
Pelletier, John D.
Pillar, Charles L.
Sabllich, John W.
Simpson, John D.
Snodgrass, J. E.
Staley, E. Keith
Thomas, Lloyd A.
Tobie, R. L.
Ward, Milton H.
Zappia, Michael A.
No Data Supplied
Dopson, C. W.
Enright, Maurice A.
Hall, Arthur B.
Hoagland, Frank E.
Karsten, Ralph C.
Payne, Keith E.
Ridinger, David C.
Seaney, Hendrik

SCOTTS DALE

*Garard, K. N.
Hughes, Robert W.
Lipphardt, Louis E.
Pennebaker, E. N.

SILVER BELL

American Smelting & Ref. Co.

Barnes, Robert A.
Conger, Harry M.
Haynes, Charles W.
Jameson, D. R.
King, Edwin B.
Knight, Arthur T.
McClain, Charles W.
Meen, R. B.
Purvis, Donald R.
Reiner, Roman A.
Rice, Howard H.
Robinson, Ellis A.
Romney, Archie B.
Salter, Russell
Sense, John J.
Staves, Harold T.
No Data Supplied
Herde, Roy

SUPERIOR

Magma Copper Co.
Augustadt, G. L.
Caldwell, Edward J.
Cooksley, Martin C.
Forker, C. B.
Gardner, Darrell
Goss, W. P.
Hammer, Donald F.
Mashaw, Robert F.
Orr, David H.
Sell, James D.
Soule, Claude L.
Steele, H. J.
Van Voorhis, B.
Ward, Albert E.
Mining Engr. Co.
Fair, John H.
No Data Supplied
Crosby, Fred
Mannheimer, L. H.
Rex, Halder J.
Sherman, Fred W., Jr.

TEMPLE

Arizona State Univ.
Nutt, Dr. Merle C.
General Electric
Hauschild, Louis W.

TONTO BASIN

National Flourish & Chem. Co.
Zinkl, Andrew J.

TUBA CITY

Rare Metal Corp. of America
Runke, Sidney M.

TUCSON

American Cyanamid Co.
McAllister, J. A.

American Exploration & Mining Co.

Johnson, F. T.

American Smelting & Ref. Co.

Courtright, J. H.

Fall, Samuel C.

Hall, Arthur Curtis

Kinnison, John E.

Morrison, Bert C.

Richard, Kenyon E.

Snedden, T. A.

Welch, Reed F.

Anacoda Co.

*Barber, G. A.

Brown, Calvin C.

Kelly, James L.

Banner Mining Co.

Bowman, Allan B.

Fraps, Conrad L.

Venable, B. W.

Bob Barrett Machinery Co.

Barrett, Bob

Bear Creek Mining Co.

Jacobson, Herbert S.

Kurtz, William L.

*Robinson, Raymond F.

Rose, Arthur W.

Smyth, Sam K.

Walker, Bryant D.

Brittain-Hendrickson Mining Co.

*Brittain, Dale Charles

Cerro De Pasco Corp.

Asher, Rodrick R.

Skarbek, John S.

Colorado Fuel & Iron Corp.

Klein, Eugene F.

DUVAL

Sulphur & Potash Co.

Atwood, George E.

Buchelle, Frank H., Jr.

Curtis, C. H.

Messer, Ben G.

Phillips, I. B.

Heinrichs Geoxplor. Co.

*Heinrichs, E. Grover

*Heinrichs, Walter E., Jr.

*Marlatt, John W.

Hoagland & Dodge Drilling Co.

*Dodge, Theodore A.

*Seel, Charles P.

Hughes Aircraft Co.

*Walker, W. W.

Infleco Inc.

Rau, Earl L.

Lewisohn Copper Corp.

Chilson, Richard E.

Metler Bros. Drilling Co.

Metler, Edward R.

*Metler, Frank C.

The New Jersey Zinc Co.

Teet, John E.

Titely, Spencer R.

Oil & Mineral Res.

Barton, Joseph C.

Sherwood B. Owens Interests

Owens, Sherwood B.

Pima Mining Co.

Beebower, Arthur G.

Friedman, A. A.

Hunt, Alan W.

*Komadina, George A.

*Martin, Michael D.

Nicholson, Marion H.

*Spaulding, E. D.

*Thurmond, Robert E.

Southern Arizona Bank & Trust Co.

Douglas, Lewis W.

Southwest Ventures Inc.

Lowell, J. David

Stearns-Roger Mfg. Co.

Head, Paul A.

Sunrise Mining Co.

Nye, Thomas S.

Transarizona Resources Inc.

*Freeman, George A.

Union Oil of Calif.

Luzadder, J. F.

U.S. Bureau of Mines

Farnham, L. L.

Hardwick, William R.

Kyburz, Edward P.

*McKinney, William A.

Rampack, Carl

Romslo, T. M.

*Roseveare, Geo. H.

Stewart, Lincoln A.

Storms, W. R.

Wideman, Frank L.

Wilson, Eldred D.

U.S. Geological Survey

Emerick, William L.

Univ. of Arizona

Balla, John C.

Chaplin, D. M.

Chapman, Thomas G.

Cunningham, J. B.

Dotson, Jay C.

*Dreval, Elmer R.

Evensen, Charles G.

*Forrester, J. D.

*Lacy, Willard C.

Laughlin, A. William

*Olson, Harry J.

Michel, Fred A., Jr.

*Smith, Sigmund L.

Wertz, Jacques

Vought & Cloeter Ltd.

Cioeter, John J.

No Data Supplied

Allen, William R., Jr.

Ballam, Jack C.

Bentzen, Charles M.

Berg, J. Edward

Blucher, A. G., Jr.

Boggs, W. B.

Brough, Paris V.

Burt, Curtis F.

Butler, B. S.

Byrkit, James W.

Chambers, Arthur E.

*Clark, Jackson L.

*Congdon, Stephen H.

Connelly, Thomas G.

*Cribbs, Richard E.

Den Bears, Dirk

Dicosola, R. D.

*Duff, Grover J.

Erickson, Kenneth L.

*Fair, Charles L.

Haire, Robert T. O.

Hare, Charles E.

Harvey, Norman L., Jr.

Haworth, A. H.

Hayes, F. H.

Hearon, Tom E.

*Heineman, Robert E.

*Holderness, Edward

Humphrys, Archie V.

Jackson, Guerdon E.

Jinks, Jim E.

Journey, John A.

Keevan, Michael W.

Kellher, D. A.

Kumke, Chas. A.

Lansing, Bronson C.

Lindenau, E. M.

*Loerpel, W. H.

Longshore, Chas. T.

Mackay, Arthur G.

Maddox, George E.

Martin, Keith

Menges, S. L.

*Mitcham, Thomas W.

Morton, Erie D.

Newman, David F.

Patten, T. M.

*Phelps, Harlow D.

Phillips, L. W., Jr.

Ribbie, George E.

Richardson, Carl B.

Sawyer, Thorp D.

Splane, John L.

*Stephens, F. M.

*Still, R. C.

*Stone, Edwin A.

Swenson, Carl R.

Thomas, Robert W.

Turney, P. M.

Verity, Victor H.

Vought, Leland C.

Waidler, W. W.

Waite, John W.

Wallace, Wayne K.

WARREN

No Data Supplied

Gilbert, A. J.

Hunt, William J.

Metz, Harry E.

Newett, John W.

WICKENBURG

Mohave Mining & Milling Co.

*Lynn, Harold F.

Pate, M. L.

Whitney, L. Earl

WINDOW ROCK

The Navajo Tribe

Collins, C. V.

WINKELMAN

Inspiration Cons. Copper Co.

Eastlick, John T.

Kuhn, John G.

*Vanderpool, John S.

YARNELL

No Data Supplied

Lankin, John L.

*Lynn, Harold F.

Pate, M. L.

Whitney, L. Earl

Wickens, George A.

Union Oil of Calif.

Luzadder, J. F.

U.S. Bureau of Mines

Farnham, L. L.

Hardwick, William R.

Kyburz, Edward P.

*McKinney, William A.

Rampack, Carl

Romslo, T. M.

*Roseveare, Geo. H.

Stewart, Lincoln A.

Storms, W. R.

Wideman, Frank L.

Wilson, Eldred D.

U.S. Geological Survey

Emerick, William L.

Univ. of Arizona

Balla, John C.

Chaplin, D. M.

Chapman, Thomas G.

Cunningham, J. B.

Dotson, Jay C.

*Dreval, Elmer R.

Evensen, Charles G.

*Forrester, J. D.

*Lacy, Willard C.

Laughlin, A. William

California-California

Prun Construction & Engrg.

*Prun, Jack F.
No Data Supplied
*Baukol, Philip J.
Berkefeld, Paul C.
Carouso, N. H. V.
Dickey, Robert M.
*Donaldson, W. G.
Golson, B. E.
Holmes, W. H.
Milward, Miles S.
Playter, George H.
Price, F. W.
Shaffer, Lysie E.
Strobel, Landon F.
Thiessen, Derek J.
Tibbetta, S. A.
Trask, Parker D.
Way, Herbert F.
Weck, Charles A.
*White, Lloyd C.
Univ. of Calif.
Hawkes, H. E., Jr.
*Klehn, Henry, Jr.
Meyer, Charles
Moyrihan, James T., Jr.
Pulcher, Stephen H.
*Rathbun, Grove A., Jr.
*Ravitz, S. Frederick
*Ward, Stanley H.

BEVERLY HILLS

Casiano Co.
Doheny, Patrick A.
No Data Supplied
Allebach, Karl A.
Boyd, Robert R.
Deavitt, William J.
McEntee, Frank J.
Platt, James M.
*Prout, John W., Jr.

BISHOP

Ajax Tungsten Corp.
*Hall, Clarence H.
Union Carbide Nuclear Co.
*Chamberlain, Richard E.
*Kunkel, Clair M.
Martinson, John E.
McKinley, H. L.
Sausa, L. E.
*Sullivan, John H.
Wright, Lawson A.
*Wyman, Donald J.
No Data Supplied
McGuire, Philip C.
Preston, Gerald L.
Stokes, Earle B., Jr.

BLYTHE

Eldorado Mine Contracting Co.
Zagar, Anton Jos.
No Data Supplied
Smith, Lucien W.

BORON

U.S. Borax & Chem. Co.
Rietheimer, Walter
Ruark, J. R.
Wamsley, Willis H.
No Data Supplied
Hardy James G.
Kendall, R. E.
Smith, Francis M.
Szell, Stephen

BRICELAND

No Data Supplied
*Cregar, George

BURBANK

Moore Engineering Co.
*Moore, Frank C., Jr.
No Data Supplied
*Smith, Kenneth A.

BURLINGAME

No Data Supplied
Busey, Alfred P., Jr.
*Dakin, Frederick H.

CALEXICO

No Data Supplied
España, Salvador

CANOCA PARK

Rocketdyne
Silva, Jay F.
No Data Supplied
*Burdick, Sherman R.

CARLSBAD

No Data Supplied
Vail, Richard H.

CARMEL

Western Core Drill, Inc.
*Read, Vernon
No Data Supplied
Hoffmann, Ross B.
Mills, Carl E.

CARMICHAEL

No Data Supplied
Skje, Roger E.

CARPINTERIA

No Data Supplied
*Rohrer, S. Lewis

CHINA LAKE

U.S. Naval Ordnance Test Station
Engel, Rene L.

CHULA VISTA

No Data Supplied
*Lincoln, Francis C.

CLAREMONT

No Data Supplied
McKenna, D. C.
Welday, Edward E.

COALINGA

The Confidence Oil Co.
Fleisher, George G.

COLTON

Calif. Portland Cement Co.
Joyce, John E.
Concrete Conduit Co.
*Van Dell, John E.

COMPTON

No Data Supplied
Gilmore, Gerald M.

CONCORD

No Data Supplied
Cook, Fred W.
Cox, Phillip W.
*Pesonen, Paul E.
Williams, C. F.

CORNING

No Data Supplied
Labarthe, Warren A.

CORONA

No Data Supplied
Hallsted, James M.

CORONA DEL MAR

No Data Supplied
Ellis, Ernest Wm.

CORONADO

No Data Supplied
Fitch, Walter

COSTA MESA

No Data Supplied
Fiske, Richard J.

COVINA

No Data Supplied
Deason, William F.

CULVER CITY

No Data Supplied
Atherton, H. L.

CUPERTINO

No Data Supplied
*Blanchard, Floyd M.

DANA POINT

No Data Supplied
Clark, Alan B.

DANVILLE

No Data Supplied
*Nichols, C. R.

DEL MAR

No Data Supplied
Kingard, A. R.

DIAMOND SPRINGS

Dia. Spgs. Lime Co.
Locke, R. S.

DOWNEY

North American Aviation
Mocium, A. T.

DOWNIEVILLE

Best Mines Co., Inc.
Huelsdonk, Lewis L.
No Data Supplied
Reed, W. T., Jr.

EAGLE MOUNTAIN

Kaiser Steel Corp.
*Davis, Carl E.
*Forbes, Richard C.
Hughes, Martin J.
Reno, Charles W.
Savage, William W.
*Scott, Harrison S.
Urso, Philip J.
No Data Supplied
Brunnett, R. Wm.
McCormick, Earl L.

EARP

Empire Mines
Cornejo, L. A.

EL CENTRO

John D. Hess Test. Corp.
*Hess, John D.
No Data Supplied
Hart, John R.

EL CERRITO

No Data Supplied
Gretlum, Donald

EL MONTE

No Data Supplied
Goodale, George S.
Mackay, Robert L., Jr.

EL SEGUNDO

Menardi & Co.
Menardi, H. B.

EMERYVILLE

Shell Dev. Co.
Fidiam, James F.
Wachter, Aaron

ESCONDIDO

No Data Supplied
Williams, Jos. A.

EUREKA

U.S. Forest Service
Blodgett, David P.
No Data Supplied
Wilson, Elmer

FEATHER FALLS

No Data Supplied
Nugent, Lee

FIVE POINTS

Lassen Market
Gong, Chung Cho

FONTANA

Kaiser Steel Corp.
Heers, Robert G.
*Kirkner, William L.

FOREST HILL

Home Ticket, Ltd.
*Wilson, Wm. E.

FORT ORD

U.S. Army
Winter, Walter A.

FRENCH GULCH

Brown Bear Mines
Erich, Ezra E.

FRESNO

Calif. Div. of Hwys.
*Hellerich, George
McGuire & Henricksen
*Henricksen, Ray
Oso Oro Mining Co.
Scoville, Ogden D.

The Twining Lab
*Twining, Frederick W.
No Data Supplied
*Hellerich, George W.
Rapp, F. A.

GEORGETOWN

No Data Supplied
De Berry, Fred G.

GLENDALE

No Data Supplied
Bakewell, A. A., Jr.
Daniel, John, Jr.

GRASS VALLEY

New Verde Mines Co.
Bennett, E. R.
Fitzpatrick, H. R.
No Data Supplied
Brown, Earl H.
Ferguson, Claude
Foote, Arthur B.
Nobs, F. Wm.
Tremoureux, Roy E.

GUERNEVILLE

No Data Supplied
Larsen, Herbert F.

HAWTHORNE

Northrop Corp.
*DiGregorio, Vincent

HEALDSBURG

No Data Supplied
Gowing, F. A.
Harper, John B.

HEMET

No Data Supplied
d'Autremont, Charles M.

HOLLYWOOD

No Data Supplied
Healy, Al J.
Rider, Ezra B.

HORNITOS

Mount Gaines Mine
*Siefert, J. A.

HUNTINGTON PARK

N. A. D'Arcy Co.
*D'Arcy, Nicholas A.
No Data Supplied
*MacAfee, Merrill W.

IDRIA

New Idria Ming. & Chem. Co.
Hurley, F. S., Jr.
Lewis, C. Hyde
Linn, Robert K.
Shaddock, Wesley L.
Ward, Mark Leonard

INDEPENDENCE

No Data Supplied
Brierly, A. A.

INDIO

No Data Supplied
Hunsaker, Otto L.

INGLEWOOD

Grand Central Ming. Co.
Potter, Parke
No Data Supplied
Blickensderfer, F. C.
Todd, Donald D.

IONE

Gladding-McBean & Co.
Coke, Hugh W.
Craven, William P.
Elias, J. Morrow
No Data Supplied
Merwin, Roland W.
*O'Brien, Glen T.

JULIAN

No Data Supplied
Glahn, Reginald A.

KELSEYVILLE

No Data Supplied
Field, Ross

KENTFIELD

No Data Supplied
Maltzahn, D. W.

KENWOOD

No Data Supplied
Goff, Ernest A., Jr.

LA CANADA

No Data Supplied
Browning, Carleton P.

LA CRESCENTA

No Data Supplied
Collins, Glendon E.

LA FAYETTE

No Data Supplied
*Barnett, George I.
*Gaillard, John G.
Lindsay, A. K.
Longtin, Garth A.
McCardle, Jack B.

LAGUNA BEACH

Kerr & Co.
*Kerr, John Leeds
No Data Supplied
Franklin, Richard H.

LA HABRA

No Data Supplied
Dionne, Maurice J.
*MacLeod, Norman A.
Worthen, A. L., Jr.

LA JOLLA

No Data Supplied
Boyd, Newton C.
Pelton, Roger T.
Schmidt, Caspar A.
Stapler, James B.

LENNOX

No Data Supplied
Krellenstein, L.

LEWISTON

Trinity Dam Contractors
Lindquist, John T.

Trinity Dredg Co.
Smith, Mary E.

LIVERMORE

Coast Mfg. & Supply Co.
Nelson, F. W.

Univ. of Calif.
*Adelmann, C. Richard, Jr.
Woolster, David L.

LOCKEFORD

No Data Supplied
Grant, R. C.

LOMPOC

Johns Manville Prods. Co.
Schuknecht, George G.
Sphar, C. W.

Missile City Rock Co.
Richardson, W. Neil

No Data Supplied
Kelly, H. Allen

LONE PINE

No Data Supplied
Skinner, Paul M.

LONG BEACH

No Data Supplied
*Belliveau, Richard M.
Marquand, A. B.
Ruby, Frank A.
*Seymour, Oliver G.

LOS ALTOS

C. E. Bradberry & Assoc.
*Jenkins, Olaf P.
*Jenkins, William O.

No Data Supplied
Bailey, Leo C.

Coulter, Harold B.
Hoffman, Ralph N.
MacLeod, George

Patty, Dale F.
Ranlett, C. A., III

*Sampson, J. H.
Welhaven, Alf

LOS ANGELES

Alaska Juneau Gold Mfg. Co.
 *Bradley, Philip R., Jr.
 Allis-Chalmers Mfg. Co.
 Blumle, T. R.
 Alloy Steel & Metals Co.
 McKean, John M.
 American Manganese Sil.
 Molyneux, Norman
 Amer. Mineral Co.
 Stewart, Blair W.
 Amer. Potash & Chem. Corp.
 Dunn, Parker S.
 Patchick, Paul F.
 Weishaupel, Franklin J.
 Arizona Metals Co.
 *Langley, Ralph R.
 Calif. Div. of Mines
 Gray, Clifton H., Jr.
 Troxel, Bennie W.
 Wright, Lauren A.
 Chain Belt Co.
 DeMott, Robert W.
 Charles, Ryan & Rivers, Inc.
 Charles, W. W., Jr.
 Chemical Mfg. Co. Inc.
 *Chase, H. P.
 City of Los Angeles
 Woodruff, Seth D.
 Climax Molybdenum Co.
 Goben, John L.
 Collier Carbon & Chem. Co.
 Wombacher, Archer
 Cons. Rock Prod. Co.
 Blair, John H.
 Continental Oil Co.
 Novotny, Stephen T.
 Coronado Copper & Zinc Co.
 Gray, Fred E.
 Cyprus Mines Corp.
 Allen, Paul W.
 Grant, Mostyn G.
 Hansen, James G.
 *Hendricks, Robert J.
 Mudd, Henry T.
 Rundle, W. J.
 Six, Clarence W.
 Welker, Kenneth K.
 Daniel, Mann, Johnson
 Mendenhall & Assoc.
 Bennett, J. Gordon
 Dow Chemical Co.
 Carlin, James J.
 Eisenhauer Labs.
 *Eisenhauer, Ed., Jr.
 Fairchild Aerial Surveys, Inc.
 Eliel, Leon T.
 *Hirrich, Frederick Woods
 General Petr. Corp.
 Landon, Robert E.
 Morrison, John A.
 Gladding, McBean & Co.
 Brooks, Richard F.
 *Nichols, Norman M.
 Grand Canyon Lime & Cement
 Co.
 *Schirm, John Stephen
 Great Lakes Carbon Co.
 Marlett, DeOtis L.
 Stone, W. D.
 Hewitt-Robins, Inc.
 Von Migula, Gerhard
 Holmes & Narver, Inc.
 *Pack, Phillip Darrel
 Johns-Manville
 Anklem, J. Richard
 Int'l. Nickel Co., Inc.
 Zima, Albert G.
 Kennedy Minerals Co.
 Kennedy, John J.
 Link-Belt Co.
 Bugbee, Earl H.
 MacAfee & Co.
 *MacAfee, Donald B.
 Maine Machine Works
 *Hartman, Wm. W.
 Monolith Cement Co.
 Williams, Duncan R.
 National Lead Co.
 *Ratcliffe, Geo. L.
 Occidental College
 Birman, Joseph H.
 Pacific Clay Products
 *Rogers, Gregory L.
 Pacific Electric Ry. Co.
 *Walker, Albert G., Jr.
 Panacalite Pacific, Inc.
 *Laylander, King C.
 The Ralph M. Parsons Co.
 Houston, Fred K.
 Research Inc.
 *Freeman, Gerald Warren
 Roberts & Assoc.
 *Dorenfeld, Adrian C.
 Sawyer Pet. Co.
 Sawyer, Joseph Addison
 Shell Oil Co.
 McLachaney, J. D., Jr.
 H. A. Shiffer, Assoc.
 Shiffer, Harvey A.
 Sill Labs.
 *Morgan, Harry J.
 *Sill, Harley
 So. Calif. Edison Co.
 West, Philip J.

So. Calif. Minerals Co.
 Skoeb, T. A.
 Southwestern Engrg. Co.
 Dwyer, John E.
 Kasevniak, Joseph J.
 Kennard, M. J.
 Miller, Robt. P.
 Southwestern Portland Cement
 Co.
 Moore, Horace S.
 Stauffer Chemical Co.
 Lindsay, Charles A.
 Thor Power Tool Co.
 Hunn, W. B.
 McNabb, Donald G.
 Sandvig, Robert L.
 Timken Roller Bearing Co.
 Haldeman, Larry J.
 Kaess, James D.
 Union Engineering Co.
 *Snyder, B. M.
 Union Oil Co. of Calif.
 Morris, Lawrence K.
 Whiting, Dwight
 Union Pacific Railroad
 *Marsh, James A.
 U. S. Borax & Chemical Corp.
 Gower, Harrison P.
 *Hersey, Lynn
 Smith, Eugene D.
 Smith, J. P.
 U.S. Corps Engineers
 Walker, William J.
 U.S. Geol. Survey
 Wayland, Russell G.
 U.S. Internal Revenue
 O'Keefe, John J.
 U.S. Lime Prod. Corp.
 *Grindell, L. N.
 U.S. Rubber Co.
 Tise, Wm. R.
 Univ. of Calif.
 *Carlisle, Donald
 *Slichter, Louis B.
 Univ. of So. Calif.
 *Clements, Thomas
 Utah Construction Co.
 *Bouret, Weston
 Victaulic, Inc.
 Squibb, H. David
 Western Precipitation
 Schneider, Gilbert G.
 No Data Supplied
 *Arciniega, Victor M.
 Arthur, Edward
 Baldwin, John E.
 Beaudin, Philip F.
 Blades, Ernest O.
 Browning, William C.
 Butler, Wallace P.
 *Campbell, A. B.
 Carpenter, Alvin B.
 *Caulfield, J. Parnell
 Chiappella, S. E.
 Dub, Geo. D.
 Flack, Sloan
 Heberling, William G.
 Hefty, H. L.
 *Hoylman, H. Wayne
 Kumer, H. J., Jr.
 Larsen, Delmar H.
 *Leggett, H. B.
 Lindau, S. P.
 Lord, Robert
 *MacAfee, Robert D.
 McKenzie, John D.
 Midgley, Tom, III
 Miller, R. T.
 Minard, Fred H.
 Moir, A. D.
 Nilsson, Geo. W.
 *Prior, Charles E.
 *Pruss, Donald E.
 Raiselis, John G.
 Reagan, Donald W.
 Roberts, Edw. J.
 Schmidt, F. Sommer
 Schroter, G. Austin
 *Spellmeyer, S. A.
 Stein, S. E.
 Sullivan, J. Thiel
 Tobelman, Henry A.
 Vedder, Dwight G.
 Wartenweiler, Otto
 Wilson, G. Benton

LOS GATOS

Continental Materials Corp.
 Heikes, George Conard
 No Data Supplied
 Bagley, Earle M.
 *Ferron, Robert D.
 *Humphrey, H. B.
 *Kelsey, Royal W.
 *O'Kelley, Wm. A.

LUCERNE VALLEY

Permanente Cement Co.
 Close, James E. H.
 *Lucas, John H.

MARICOPA

Berry Holding, Co.
 Bush, Wm. E.

MARTINEZ

Mountain Copper Co. Ltd.
 Watson, Stanley G.

MENLO PARK

Utah Construction Co.
 Gay, Sylvester P., Jr.
 Hubert, Joseph P.
 Kundert, Charles J.
 Nelson, William H.
 U. S. Geological Survey
 Brew, David A.
 Campbell, Russell H.
 Hewett, Donnel F.
 Jones, C. L.
 Lemmon, Dwight M.
 MacKevett, E. M., Jr.
 Sandberg, C. H.
 Stanford Research Inst.
 *Foote, Richard M.
 Hill, M. D.
 Hoy, Robert B.
 Huber, George B.
 *Tarrice, Richard R.
 No Data Supplied
 Beatty, W. B.
 Bethel, H. L.
 Burton, C. E.
 De Huff, William H.
 *Howes, Warren L.
 *Landwehr, W. R.
 Locke, Augustus
 Newsom, J. B.
 *Perry, Joseph B.
 *Seales, G. W.
 Steffens, Carsten
 *Stejer, Francis A.
 Vandel, Gailen T.
 Walker, Fred D.

MIDWAY CITY

King & King
 *King, Clarence R.

MILL VALLEY

No Data Supplied
 Bromblay, J. C.
 Glas, Anatol
 *Swearingen, John D.
 Woods, Peter G., Jr.

MONOLITH

Monolith Portland Cement Co.
 Goldman, Alfred S.

MONTEBELLO

No Data Supplied
 Danziger, J. M.

MONTEREY

No Data Supplied
 *Landers, Wm. H.

MOSS BEACH

No Data Supplied
 Watson, Edwin J.

MOUNTAIN RANCH

No Data Supplied
 *Poore, Geo. B., Jr.

MOUNTAIN VIEW

Hodges Chemicals Co.
 Oliver, E. L., Jr.

MURPHYS

No Data Supplied
 Hastings, A. T.

NATOMA

Natomas Co.
 Wells, John H.

NEVADA CITY

Alpha Hardware Co.
 Tremoreux, Roy C.
 Espy Mining Co.
 Eastman, Byron Lee
 No Data Supplied
 *Billick, Don Carlos
 *Siegfried, J. F.
 Simkins, Wm. A.
 Todd, Wallace

NEWPORT BEACH

No Data Supplied
 Bailey, Robert D.
 Bell, Jerry Y.
 Bush, Harry E.

NIPTON

Molybdenum Corp. of Amer.
 Lee, Chris H.
 *Wood, L. Russell
 Pacific Fluorite Co. of Calif.
 Lineberry, S. M.

NORTH HOLLYWOOD

No Data Supplied
 Peterson, Nathaniel C.
 Pinkney, H. D.

NOVATO

Wright Engrg. Assoc.
 *Wright, W. Q., Jr.
 No Data Supplied
 Klitz, Alton E.

OAKLAND

Amer. Pulley Co.
 Weishaar, G. F.
 The Colo. Fuel & Iron Corp.
 Lee, David L.
 Cook Bros.
 Bilestein, Gunter J.
 Dorr-Oliver
 Burnt, Thomas E.
 Hardin, Donald C., Jr.
 *Tarr, Donald T., Jr.
 Glenn Co.
 Glenn, George G.
 Henry J. Kaiser Co.
 Barneyback, Robt. S.
 Conwell, James A.
 Price, Thomas M.
 Kaiser Alum. & Chem. Corp.
 Bingham, Clarence P.
 Brooke, J. K.
 Clarke, Otis M., Jr.
 Davis, Geo. C., Jr.
 Fowler, Hedley S.
 Hassan, E. A., Jr.
 Heuck, Arthur W.
 Knight, Joseph F.
 Kurtz, Horace F.
 *Shaffer, James W.
 Kaiser Engrs.
 Bates, Ralph G.
 Blymyer, Eugene B.
 Hahne, Werner H. E.
 Henderson, J. Frank
 *Hyatt, Wesley
 *Milliken, Clinton L.
 Montez, Donald K.
 *Thompson, James V.
 Kaiser Gypsum Co.
 Chavez, Antonio
 Read, Myron
 Oakland City College
 *Gerlach, Keith H.
 Owens Illinois Glass Co.
 Heindel, Richard W.
 *Slade, W. W.
 Strachan Machinery Co.
 Strachan, Douglas
 West End Chemical Co.
 Stampley, Richmond
 U.S. Bureau of Mines
 Felegy, E. W.
 No Data Supplied
 Canfield, G. H.
 Cox, Thomas
 Daily, Arthur F.
 Fox, Samuel R.
 Latham, Marc L.
 Logan, William W.
 *Parsons, Arthur B.
 Sisson, W. E.
 Wright, Allen J.
 Young, Robert K.

OCEANSIDE

No Data Supplied
 Hendrickson, D. G.

OIDDALE

No Data Supplied
 Hoffman, Ekvub M.

ONTARIO

No Data Supplied
 Buchholtz, H. F.

ORINDA

No Data Supplied
 *Hulin, Carlton D.

ORO GRANDE

Riverside Cement Co.
 Pflug, Gordon E.
 Wilkinson, Cecil H., Jr.

OXNARD

Vaca Oil Co., Inc.
 Stehle, Carl, Jr.

California-California

PACIFIC PALISADES

No Data Supplied
 *More, Richard F.
 *Wicks, Frank R.

PALM SPRINGS

No Data Supplied
 *Guise, Merle H.

PALO ALTO

Cooper & Clark
 *Atkinson, Sterling K., Jr.
 Cordoro Mining Co.
 *Gilbert, J. Eldon
 *Gumucio, Julio F.
 *Hager, Edward H.
 *Williston, Samuel H.
 E. I. Du Pont de Nemours &
 Co.
 *Croze, Walter W. J., Jr.
 Equipment Engrs., Inc.
 Clarkson, John Robert
 Green, F. C., Jr.
 Krebs, Richard
 Norman, L. A., Jr.
 Utah Const. Co.
 *Buchanan, Edward
 Chamberlin, Richard A.
 *Corson, Alexander
 DeMel, Frank J.
 Mann, Homer A.
 *Reinmiller, Frank W.
 *Shaw, Douglas M.
 Wallace, Keith G.
 No Data Supplied
 Coblmeier, S. H.
 Dofozo, Silas L.
 George, Joseph L.
 Greenlee, B. B.
 Hamm, John P.
 Krebs, Kellogg
 Madison, Frank J.
 Mahroz, W.
 Marshall, S. M.
 Peterson, Donald W.
 Reck, Wm. H.
 Spencer, Arthur C.
 Sprague, William E.
 Taber, Bond
 Washburn, Howard G.
 Wilmot, H. C.
 Wright, Louis A.
 Wynne, Gordon R.

PASADENA

Calif. Inst. of Tech.
 *Frink, Ellis P.
 Jahn, Richard H.
 Lanphere, Marvin A.
 *Manning, Dr. Paul D. V.
 Converse Fdn.
 *Clweck, Blase A.
 United Geophysical Co.
 Blackie, Benson D.
 No Data Supplied
 Adams, Henry F.
 Bailey, Florent H.
 Cowans, Frederick
 Doerr, Albert E.
 Edwards, M. G.
 Holman, J. R.
 Holman, Marshall G.
 Howell, B. N.
 Lindvall, Charles E.
 Miller, Jared H.
 Moran, Robt. B.
 Myers, Desaix B.
 *Noble, James A.
 Potter, C. C., Jr.
 Simmons, Edw. E., Jr.
 *Tally, Robt. E.

PASO ROBLES

Amer. Smelt & Refin. Co.
 Eimon, Paul I.

PEBBLE BEACH

Del Monte Properties
 Bein, Hugh H.
 No Data Supplied
 Osborne, Richard

PERMANENTE

Kaiser Alum. & Chem. Corp.
 Brandt, Robert E.
 Fuerstenau, D. W.
 Permanente Cement Co.
 Jack, Orville E.

PICO

No Data Supplied
 Morton, Paul E.
 Smith, Frank T. A.

California-California

PIEDMONT

No Data Supplied
 *Borden, Granville S.
 Dorris, John B.
 *Goodrich, Wm. H.
 Hale, Elwyn G.
 *Heidenreich, W. Lee
 Love, Colin L.
 Schurmacher, G. L.

PINE GROVE

No Data Supplied
 Banks, Leon M.

PITTSBURG

The Dow Chemical Co.
 Harris, Guy H.
 Long, Ray S.
 Olson, Robert S.
 Tvetter, Elmer C.

PLACERVILLE

No Data Supplied
 Pickering, Joseph

PLASTER CITY

No Data Supplied
 Davies, Calvin O.

PLEASANT HILL

No Data Supplied
 Plimpton, H. Gilbert

POINT MUGU

PMR NAMTC
 Erickson, B. H.

POMONA

Convair Co.
 *Kline, James A.
 Pomona Tile Mfg. Co.
 Hammer, Jordan A.
 No Data Supplied
 Allen, Harry P.

PUENTE

No Data Supplied
 Fleming, Allen

RAMONA

No Data Supplied
 *Marshall, Karl L.

RANCHO

No Data Supplied
 Vallat, Benjamin W.
 Wolfaro, Merl R.

RED BLUFF

No Data Supplied
 *Nielsen, G. W.
 Valov, Igor

REDDING

Mountain Copper Co.
 Barcus, Robert K.
 Winsor, Donald K.
 Walker Engrg. Corp.
 *Walker, Woodville J.
 Div. of Highways
 *Aramayo, Luis
 No Data Supplied
 Murphy, John X.

REDLANDS

Filer's
 Filer, Alexandra T.
 No Data Supplied
 Jahn, Gustave A.

RED MOUNTAIN

No Data Supplied
 *Gardner, Dion L.

REDWOOD CITY

No Data Supplied
 Cheavens, John H.

RIALTO

No Data Supplied
 *Hancock, Sam
 Michaelson, J. P.

RICHMOND

City of Richmond
 Bynum, Charles G.
 Pacific Minerals Co. Ltd.
 Renwick, Charles S., Jr.

Stauffer Chem. Co.
 Mannion, L. E.
 No Data Supplied
 Palmer, Harry B.

RIVERSIDE

Amer. Cem. Corp.
 Walls, Marion B.
 Hunter Engrg. Co.
 *Gustafson, R. A.
 Riverside Cement Co.
 Chandler, Charles D.
 Freeland, Robert E.
 Logan, A. H.
 Nalle, Peter B.
 Smyd, Theodore M.
 Tuttle, Jay, III
 Weeks, Leftoy Wm.
 Wightman, Randall H.
 No Data Supplied
 Dafeo, E. W.
 Mills, Eugene A.
 *Thomas, Geo. G.

ROLLING HILLS

No Data Supplied
 Lewis, Albert A.

SACRAMENTO

Aerojet-General
 Sheppard, Ben L.
 Calif. Dept. of Water Resources
 Dettman, Steven S.
 Iwamura, Thomas I.
 *Nazarek, Eugene A.
 *Schubbe, Dean R.
 Calif. Div. of Mines
 Clark, William B.
 Natomas Co.
 Smith, Richard G.
 Scandia Mines
 *Smith, Charles R.
 State of Calif.
 Barclay, James
 U.S. Bureau of Land
 Zentner, Steve
 *Sharp, Alan A.
 U.S. Geol. Survey
 Erickson, P. C.
 U.S. Army Corps of Engrs.
 *Sheffield, Douglas A.
 J. H. Wren & Co.
 *Wren, James H.
 No Data Supplied
 *Ash, James L.
 *Ash, Col. S. H.
 Brown, Otto R.
 Currie, Robert A.
 Gilmore, Chas. L.
 Haines, Wilbur H.
 Johnson, H. H.
 Lang, Henry A.
 Logan, C. A.
 Rombough, Miles D.
 Taylor, G. Cleve

SALINAS

Kaiser Alum. & Chem. Corp.
 Stephens, Robert W.

SAN ANDREAS

Calaveras Cement Co.
 Allsman, Lewis S.
 *Fuller, Willard F., Jr.
 James, John W.
 Metzger, Grant W.
 Slater, T. Calvert
 Stauber, Arthur D.
 *Weeks, Orrin D.
 No Data Supplied
 Andersen, Edgar F.
 Bagley, Earle M., Jr.
 Durland, R. M.

SAN ANSELMO

No Data Supplied
 Cutmore, David

SAN BERNARDINO

B.D.H. Corp.
 Hudson, W. T.

SAN BRUNO

City of San Bruno
 *Crosby, Jo Kent

SAN CARLOS

Sandvik Steel, Inc.
 De Jounge, Lars A.
 No Data Supplied
 Hilton, Charles R.
 Saarinen, Armas J.

SAN CLEMENTE

No Data Supplied
 Johnson, James R.

SAN DIEGO

Clary Wilkie & Assoc.
 Hart, Wood E.
 Convaiv
 Huebner, Arthur S.
 San Diego State College
 *Roberts, Ellis E.
 *Thomas, Blakemore E.
 Univ. of San Diego
 *Phillips, Richard P.
 No Data Supplied
 Kaar, Grover C.
 Lyon, Tom
 Marcy, Frank E.
 Piccini, M. J.

SAN FERNANDO

No Data Supplied
 *Botsford, C. A.

SAN FRANCISCO

Aero Serv. Corp.
 Dando, E. E.
 Allis-Chalmers
 Clasen, Dann S.
 Croft, Norton E.
 Amer. Exploration & Ming. Co.
 Goudley, Hatfield
 Scholz, Edgar A.
 Amer. Smelt & Refin. Co.
 Wilson, L. Kenneth
 James S. Baker Co.
 Baker, James S.
 The E. J. Bartells Co.
 Proctor, John
 Bear Creek Ming. Co.
 Cook, Annan
 Smythe, Donald D.
 Bechtel Corp.
 *Bjorklund, Geo. K.
 Dungan, T. A.
 *Merritt, William L.
 Russell, George R.
 *Taylor, Michael P.
 Way, G. L.
 Beth. Pacific Coast Steel
 Hurst, George P.
 Bradley & Ekstrom, Inc.
 Helmke, R. F.
 Bradley Mining Co.
 *Bradley, Worthen
 Bucyrus-Erie Co.
 Livingston, H. L.
 The Bunker Hill Co.
 Bradley, John D.
 Calaveras Cement Co.
 Barker, Edgar M.
 Curry, James T.
 Duling, Orten E.
 *Mein, Gainer W.
 Mein, William Wallace
 Mein, Wm. Wallace, Jr.
 Powell, James C.
 Woodward, Bert
 Calif. Div. of Mines
 Burnett, John L.
 Campbell, Ian
 Gary, Geo. L.
 Chesterman, Charles W.
 Davis, Fenelon F.
 *Franz, John C.
 Oakeshott, Gordon B.
 Stewart, Richard M.
 Ver Planck, William E.
 Calif. Div. of Ind. Safety
 Lutz, Kyle J.
 Smith, Emory
 Castella Corp.
 Ayres, Charles J.
 Smith, L. A.
 Castro Mining Co.
 *Hall, Durand A.
 Columbia Southern Chem.
 Corp.
 Shirley, E. R., Jr.
 Commercial Minerals Co.
 Stewart, Malcolm
 Coney Argentina, S.A.
 Joffe, Gerardo
 Cons. Purch. & Designing Inc.
 Gabriel, H. A.
 Curtis & Tompkins Ltd.
 White, George E.
 Defense Material Service
 *Burgess, Robert J.
 *Youtz, Ralph B.
 Ellicott Machine Corp.
 Romanowitz, Charles M.
 Engrs. Assoc. Inc.
 Yetter, Charles W.
 Engr. & Ming. Journal
 Hutt, John B.
 Fibreboard Paper Prod. Corp.
 Harvard, J. F.
 Lightfoot, William E.
 Fischbach & Moore Inc.
 Rosenblatt, Girard B.
 Gen. Elec. Co.
 Osborn, John F.
 Gladding McBean Co.
 Wasmann, Russell K.

Gordon I. Gould & Co.
 *Fopp, S. Michael
 *Gould, Gordon I.
 H. W. Gould & Co.
 *Gould, Malcolm B.
 Abbot A. Hanks Inc.
 Imrie, Herbert D.
 *Quist, Martin F.
 Hardinge Co. Inc.
 Nolan, Charles C.
 Hercules Powder Co.
 *Trescher, F. George
 Hewitt-Robins Inc.
 *Crow, Wallis H.
 Zinter, Theodore C.
 Homestake Ming. Co.
 Bjorge, Guy N.
 Hamilton, John W.
 Henshaw, Paul C.
 McLaughlin, Donald H.
 Breck, Parker
 Shoemaker, A. H.
 Honolulu Oil Corp.
 Waldner, Clarence E.
 E. F. Houghton & Co.
 Vieira, Joseph Louis
 Ingersoll Rand Co.
 Collyer, Wm. C.
 *Decker Robert W.
 Jacobs Assoc.
 *Jacobs, J. Donovan
 Joy Mfg. Co.
 Rhodes, L. C.
 Kern County Land Co.
 *Griswold, William T.
 Reim, Kenneth M.
 Arthur D. Little Inc.
 *Watson, William I.
 Mac Nichol & Co. Inc.
 Mac Nichol, A. W.
 McGraw-Hydrocarbon
 *Blonsky, George B.
 The Merrill Co.
 *Merrill, John L.
 Mine Safety Appliances Co.
 Butler, Kenneth S.
 Mines Engrg. & Equip. Co.
 *Taylor, William F.
 Mining World
 Dayton, Stanley H.
 The Mountain Copper Co. Ltd.
 *Kett, Laurence T. T.
 Edward J. Nell Co.
 *Mitchell-Roberts, J. F.
 Nordberg Mfg. Co.
 Davis, Thomas D.
 Makholin, L. O.
 Ocean Services Inc.
 Miller, James R.
 Ohio Ferro Alloys Corp.
 Landon, H. S.
 Orig. 16 to 1 Mine, Inc.
 Bennett, Clayton A.
 Owens-Illinois Glass Co.
 *Menober, Pearson T.
 Pacific Cement & Aggregates
 Inc.
 Hampton, George F.
 Howard, E. L., Jr.
 Kinzie, Robt. A., Jr.
 Sanford, Lester F.
 Pacific Coast Co.
 *Rust, George W.
 Sabin Engrs.
 *Sabin, Alfred B.
 San Luis Mining Co.
 Swent, James W.
 Southern Pacific Land Co.
 Anderson, Kenneth E.
 *Bonham, Harold F., Jr.
 *Cockley, James W., Jr.
 *Cunningham, Andrew B.
 *Laird, Raymond T.
 McCulloch, W. C.
 *Papke, Keith G.
 *Wright, Lawrence B.
 Standard Oil Co. of Calif.
 Cadle, Austin
 Shull, Robert V.
 Stephens-Adamson Mfg. Co.
 Cooper, Robert J.
 Sutro & Co.
 Vogt, Ernest A.
 Thurman Gold Dredging Co.
 *Thurman, Charles H.
 Traylor Engrg. & Mfg. Co.
 Kramm, Douglas J.
 Triton Engrg. Co.
 *Downey, J. Ward
 U. N. Korean Reconstr. Agency
 *Badorck, Gunther
 Bell, Enfield B.
 *Brittingham, Geoffrey J.
 Hyde, Pitt W.
 Mealey George A., Jr.
 Nonini, L. G.
 U. S. Army Corps of Engineers
 *Jones, David
 *Eddelman, W. S., Jr.
 U. S. Bureau of Mines
 Davis, L. Elton
 Dietrich, Waldemar F.
 Matson, Edward J.
 Maurer, R. B.
 Mull, J. B.

U. S. Forest Service
 Gould, Gerald E.
 U. S. Sec. & Exchange Comm.
 Dougherty, Ellsworth Y.
 U. S. Steel Corp.
 Birk, Jack N.
 Casburn, William J.
 Hamilton, Walter A.
 *Harris, Fred A.
 Henderson, A. S.
 Johnson, Vard H.
 Jones, H. H. B.
 Morgan, Ronald C.
 Mote, Karl W.
 Pruden, Worrell F.
 Sargis, S. G.
 Schebe, Max C.
 Scott, W. Kenneth
 Talbott, R. C.
 Weiler, Charles T.
 Whipple, Ross W.
 Utah Co. of The Americas
 Geiger, A. F.
 Utah Construction Co.
 Bartlett, Howard F.
 Christensen, Allen D.
 Davis, Charles S.
 Goodwin, J. Grant
 Herkenhoff, Earl C.
 Hunt, Rodney H.
 *Lancaster, Hugh K.
 Leonard, W. Drew
 Long, Ralph J.
 Mccia, J. A.
 Mullen, R. L.
 *Nelson, Everett Frank
 Riddell, Paul A.
 Torgerson, E. O.
 Wash. Const.
 Schwyz, Richard B.
 Paul Weir Co., Inc.
 *Bellows, George D.
 Western Boiler Engrs., Inc.
 *Krisber, Edward A., III
 Western Knapp Engrg. Co.
 Clark, H. L.
 *Jensen, James H.
 *McNeill, Harold J.
 Murray, G. Y.
 O'Connell, Edwin J.
 Raring, Robert H.
 Skinner, Charles F.
 Western Machinery Co.
 *Bailey, Robert S.
 *Byler, Raymond E.
 Chavez, A. B.
 Clayberg, Geo. A.
 Damon, N. C.
 Felsch, H. J.
 *Golson, Charles E.
 Hill, Jack V.
 How, Jack H.
 *Kranick, Cyril R.
 Macknight, Donald E.
 *Marcellus, Roy C.
 Mayer, Herbert J.
 Michael, W. D.
 *Mueller, Jerry K.
 Newton, Douglas E.
 Newton, Wm. H.
 *Schneider, F. V.
 Springston, David L.
 Stewart, Thomas G.
 *Utt, Ralph B.
 Wharton, B. Alan
 Wimpfen, Sheldon P.
 Wisser & Cox
 *Cox, Manning W.
 *Wisser, Edward H.
 No Data Supplied
 Adams, Robt. M., Jr.
 Allsman, Paul L.
 *Atkinson, James E.
 Austin Bert C.
 Bergis, Robert R.
 Bergman, Sheldon C.
 Bynon, Arthur F.
 *Byram, Russell R., Jr.
 Caglieri, Guido E., Jr.
 Carlisle, Henry C.
 Casey, James R.
 Catanzaro, L. A.
 Dor, Abraham
 Ervin, Waldemar M.
 Franklin, R. E.
 Franey, Henry J.
 *Frederick, Francis H.
 *Gould, Bruce A.
 Grundstedt, H. G.
 Hahn, Albert W.
 Hammon, Wendell C.
 *Hecht, Arthur S.
 *Hughes, Arthur D.
 *Jacob, Leonard, Jr.
 Jenkinson, D. W.
 Johnson, Walter W.
 *Joralemon, Ira B.
 *Joralemon, Peter
 Klaver, Anton
 *Knaus, Charles L.
 *Laird, Thomas B.
 Larken, T. P.
 Levensaler, L. A.
 Lewis, J. Volney
 *McNeil, Clayton T.

California-Colorado

<p>*McShane, Oscar T. Morbio, Carlo S. Morrison, J. B. Newsom, John H. Parsons, Lewis A. *Peale, Rodgers *Penick, Walter L. *Peshkoff, V. C. Plews, George Rawlings, Stuart L., Jr. Sackett, J. H. Sanborn, William C. Sanders, Cyril C. Smith, John H. Spencer, W. M., Jr. *Stronck, H. N. Tempest, R. B., Jr. *Thompson, Thomas West Vardy, Peter *Varney, Fred W. Verda, B. M. *Witt, Herbert N.</p> <p>SAN GABRIEL</p> <p>Smith Booth Usher Co. Lewon, Benjamin Tinker & Raser *Rasor, John P. No Data Supplied *Heron, Charles M.</p> <p>SAN JOSE</p> <p>Allied Geophysics Rose, R. Burton Food Machy. & Chem. Corp. *Barnwell, Lloyd R. Philbrook, W. R. No Data Supplied Barquist, W. S. Berg, Jerome Binasacca, W. A. Romano, C. A.</p> <p>SAN LEANDRO</p> <p>Peterson Tractor Co. Barton, Thomas V., Jr.</p> <p>SAN LUIS OBISPO</p> <p>Madonna Construction Co. Collord, James State of Calif. Div. of Highways Cushwa, Claude C. No Data Supplied Stallwood, Robert B.</p> <p>SAN MARINO</p> <p>No Data Supplied Loel, Wayne Wittenberg, H. E., Jr.</p> <p>SAN MATEO</p> <p>Chemagro Corp. Benham, Jack L. The Elmco Corp. Schepman, Berne A. Process Engrs. Inc. *Kivari, A. M. No Data Supplied Burmester, L. R. *Joubert, Louis J. Kett, Frederick F. *Mercier, Stanley M. *Stickney, Alfred W.</p> <p>SAN PEDRO</p> <p>R. J. Dalton & Sons *Dalton, Robert J.</p> <p>SAN RAFAEL</p> <p>No Data Supplied Dunster, C. B. Mitchell, Miles J. *Moretti, Louis R.</p> <p>SANTA ANA</p> <p>No Data Supplied Ayers, A. M. Butler, G. Montague *Williams, George K. *Young, Edward L.</p> <p>SANTA BARBARA</p> <p>U. S. Geol. Survey Miller, Glen A. No Data Supplied Mills, Harold F. *Tillia, H. J. Wilson, R. R.</p> <p>SANTA CLARA</p> <p>No Data Supplied Connors, Edward B. Jackson, Thomas A.</p>	<p>SANTA CRUZ</p> <p>No Data Supplied *Brown, Walter F. Foust, Barney</p> <p>SANTA MARIA</p> <p>Great Lakes Carbon Co. *Reinhart, Jack W. No Data Supplied Allen, Alden W. *MacMillan, R. S.</p> <p>SANTA MONICA</p> <p>Santa Monica City College *Lee, Charles Albert No Data Supplied Boyd, Wallace F. Driscoll, Robt. Edw. Lindholm, Milton S. Nebecker, Chas. M.</p> <p>SANTA ROSA</p> <p>Arbuckle Exp. Co. Fitzwilliam, Cwgl No Data Supplied Gibson, James</p> <p>SARATOGA</p> <p>Pick Mining Co. Pick, Vernon J. No Data Supplied Barton, Thomas V. Nutter, Edward H. Setinsky, Jerry H.</p> <p>SAUSALITO</p> <p>E. D. Bullard Co. Bullard, E. W. No Data Supplied *Woodworth, Selim E.</p> <p>SEBASTOPOL</p> <p>No Data Supplied *Schuette, Curt N.</p> <p>SELBY</p> <p>Amer. Smelt. & Refin. Co. Gough, C. P.</p> <p>SHINGLE SPRINGS</p> <p>El Dorado Limestone Co. *Stinson, Walter A., Jr.</p> <p>SIERRA MADRE</p> <p>No Data Supplied Blanchard, Roland</p> <p>SONORA</p> <p>No Data Supplied McClandish, W. W.</p> <p>SOUTH GATE</p> <p>Fibreboard Paper Prod. Taylor, Glen C.</p> <p>SOUTH PASADENA</p> <p>Sierra Talc. & Clay Co. Inc. Booth, Otis Kempfer, Donald B. *Mulryan, Henry Mulryan, James D. No Data Supplied Cram, Laurence L. Hughes, Herbert V. *Reis, James W.</p> <p>STANFORD</p> <p>Stanford Univ. Bennett, Joseph C. Mitchell, George W., Jr. *Park, Charles F., Jr. *Parks, Geo. A. No Data Supplied Crawford, M. D. Moore, Henry J.</p> <p>STOCKTON</p> <p>A. Teichert & Son Cole, Rordon J. Whittaker Iron Mines Whittaker, Norman A. No Data Supplied Beck, E. L. Darden, Taylor</p> <p>SUNLAND</p> <p>No Data Supplied Apell, Gideon A.</p>	<p>TARZANA</p> <p>No Data Supplied Weisenburg, L. E.</p> <p>TORRANCE</p> <p>Harvey Alum. Corp. of Amer. Loevenstein, H. *Moore, A. L.</p> <p>TRABUCO CANYON</p> <p>California Non-Metallies *Ellerman, Otto M.</p> <p>TREASURE ISLAND</p> <p>U. S. Naval Stat. Public Works Dept. *Mrock, John W.</p> <p>TRONA</p> <p>Amer. Potash & Chem. Corp. Berthold, G. E. Leonardi, M. L. *Otto, Marie F. Rockdale, Lloyd H. No Data Supplied *Darrow, Frank M.</p> <p>VALLEJO</p> <p>No Data Supplied Bisio, R. P. Radcliffe, D. L.</p> <p>VALLEY CENTER</p> <p>No Data Supplied *Tizard, William E.</p> <p>VAN NUYS</p> <p>No Data Supplied Messer, Lisle R.</p> <p>VENTURA</p> <p>No Data Supplied Martin, Robert E.</p> <p>VICTORVILLE</p> <p>Victorville Line Rock Co. *Ball, Emmett B. Jr. *Gessner, Robert H.</p> <p>VISTA</p> <p>No Data Supplied Downes, Frank A. *Moore, James I., Jr.</p> <p>WALNUT CREEK</p> <p>No Data Supplied Hewitt, Robert S. Price, C. F. B., Jr. Roe, Joseph T. Rogers, John M.</p> <p>WALTERIA</p> <p>Great Lakes Carbon Corp. Dyrsmid, Dal F.</p> <p>WEST COVINA</p> <p>No Data Supplied Crutchfield, Wm., Jr. Fogelberg, Tenny R. *Forbes, J. McLaren</p> <p>WHITTIER</p> <p>Fluor Prod. Co. Obert, L. R. No Data Supplied Angst, Harry H. *Brown, Meredith C. *Cullity, Emmet R. Harper, Thomas S. Hohne, Robert J. *Lowe, John P. *Walte, Harold A.</p>	<p>BOULDER</p> <p>Allied Chem. Corp. Pennington, James R. Tungsten Refining Inc. *Teal, George H. Western Labs. Inc. *Waters, Thomas E. Williamson Mining Co. *Williamson, Harry B. No Data Supplied Bischoff, E. D. *Johnson, Arthur F. Peiker, E. W., Jr.</p> <p>BUENA VISTA</p> <p>No Data Supplied Brown, John P.</p> <p>CAMEO</p> <p>Kerr Coal Co. Carver, Archie L.</p> <p>CANNON CITY</p> <p>Cotter Corp. Hanson, Glen E. Jordan, G. Robert Marcott, David P. No Data Supplied Arnold, William F. Cardone, Anthony T. Chase, Marvin C. Steward, John C. Ulmer, J.</p> <p>CARBONDALE</p> <p>Mid Continent Coal & Coke Co. Reeves, John A. No Data Supplied McCann, Harvey E.</p> <p>CLIMAX</p> <p>Amer. Met. Climax Achtien, Donald B. *Allen, Walter R. Atkinson, Edwin F. Barnett, Ralph M. Bender, Frederick N. Burk, Snell G. *Cleeves, Chas. A. Distler, William F. *Drechsler, Herbert D. Eisenach, Edwin J. Gregory, William J. Grossman, Eugene L. *Hareston, Wm. Henry Henderson, Robert Hoff, Fred J. Huston, Richard C. Jonson, David C. Julin, Douglas E. Meldrum, William Blair Meyertons, Ralph Petty, J. M. Powell, John William Richards, John Thomas Shore, James L. Smith, Albert K., Jr. *Stewart, Raymond M. Stillier, Orland Walde, Gordon H. Walker, Marvin S. *Wallis, Harley W. *Windolph, F. J. Wolter, J. E. No Data Supplied Gardner, Wm. C. Macintyre, J. Mc. E. Wahl, William H. Wallace, Stewart R. Wilson, William H. Ziegler, Robt. C.</p> <p>COLORADO SPRINGS</p> <p>Denver Equip. Co. Griesemer, F. J. Golden Cycle Corp. Ballard, Thomas J. *Welch, Wm. Robert Stratton CCM & D Co. *Keener, James H. No Data Supplied *Adams, Sidney F. Dodge, James S. *Matheson, Kenneth H. Murray, George Ruder, Ralph E.</p> <p>CORTEZ</p> <p>No Data Supplied *Irvine, Gordon B., Jr.</p> <p>COWDREY</p> <p>Ozark Mahoning Co. Wisco, R. K.</p>	<p>CRESTED BUTTE</p> <p>Asarco Bloomfield, G. H.</p> <p>CRIPPLE CREEK</p> <p>Golden Cycle Corp. *Carlton, Chas. H. *Poet, Stewart E.</p> <p>DELTA</p> <p>No Data Supplied Brown, George A.</p> <p>DENVER</p> <p>Allis Chalmers Mfg. Co. Moody, Richard D. American Brake Shoe Co. Bauman, Harry C. American Chain & Cable Co. Inc. Steele, Paul D. American Metal Climax Inc. Castraghi, Gilbert A. Howbert, John C. Meyer, P. A., Jr. Norman, T. E. Rostad, Ora H. Wright, Robert J. American Smelting & Refining Co. Kirkpatrick, Roger K. Perrin, J. R., Jr. Probst, Nolan Anschutz Drilling Co. *Cazier, James H. Gaz, Louis A. Atomic Energy Comm. Boyle, Thomas L. *Foran, John F. Ball Assoc. *Ball, Douglas Bear Creek Mining Co. Banghart, Roger C. Bingel, James R. Bowman, Robert Clark, Franklin F. Gilbert, Ray E. Hansen, Don A. Holmer, Ralph C. Knapp, Gregory A. Rogers, George R. *Shepard, William M. Wargo, Joseph G. Buildex Res. & Chem. Co. *Litz, Dell E. The California Co. Rankin, Rod R. Camp Bird Colo. Inc. Tremlett, C. P. Chicago Pne. Tool Co. Briggs, Orval Lon Cog Minerals Corp. Seaton, Frank A. State of Colorado *Allen, Thomas Colorado Fuel & Iron Corp. Crow, Walter L. Dorward, Howard M. Schmuck, Howard K., Jr. Scott, Richard Lee Wilson, Malcolm E. Colorado Ming. Assoc. Palmer, Robert S. Columbine Metals Inc. McMillan, W. D. Contract Engineering Co. Goddard, Paul L. *Hoyl, Alfred G. Crucible Steel Co. of Amer. Daly, Thomas W. Stark, Robert L. C & S Card Iron Works Co. Card, D. C. Denver Equipment Co. Ahlborg, William T. Flagg, Richard W. *Gisler, H. J. Johnson, Clyde V. Lintner, Robert E. Logue, Leland *Vanecek, Frank R. Wick, Keith E. Denver Fire Clay Co. Brandt, William O. Edward D. Dickerman *Dickerman, Edward D. E. I. Du Pont De Nemours & Co. Inc. Watson, Fred J. Emperius Mining Co. Foxson, B. T. Equipment Specialties Co. Davidson, Paul G. Fremont Minerals & Mines Dev. Inc. Peters, William C. *White, John B., Jr. Vogenthaler, T. Jr. Frontier Refining Co. *Parker, Ben H.</p>
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Colorado-Colorado

Gardner Denver Co.
Rapp, Arnold E.
Riemann, C. H.
General Electric Co.
Mehl, Clinton D.
General Services Administ.
Winters, Verne W.
Global Exploration Co.
*Thompson, Raymond M.
Harnischfeger Corp.
Sullivan, E. J.
G. R. Harris & Co.
Harris, George R.
E. K. Hartzell & Assoc.
*Hartzell, E. K.
H. L. Hazen Inc.
*Hazen, H. L.
Hercules Powder Co., Inc.
Perse, Franklin H.
Ray, F. A.
Hewitt Robins Inc.
Leckner, Glenn G.
Humphreys Engineering
Snedden, Henry D.
Humphreys Gold Corp.
Humphreys, Albert E.
McKinley, Frank M.
Humphreys Investment Co.
Humphreys, I. B.
Ideal Cement Co.
Douglas, Thomas B.
Phillips, Earl C.
Ingersoll Rand Co.
Shaw, Richard H.
The Mace Co.
Mace, Clement H.
McGraw-Hill Publ. Co.
Patterson, John W.
The Mine & Smelter Supply Co.
*Drinkwater, D. J.
Barbella, Elmer J.
Kautz, Harry P.
Seep, Albert E.
Shiell, Arlous E.
Thompson, Charles F.
Morse Bros. Machinery Co.
Cox, Buford B.
Grimes, Harold N.
Mountain States Instru.
*Spalding, Robt. S.
National Fuse & Powder Co.
Hill, Arthur Lefevre
Charles O. Parker & Co.
*Parker, Charles O.
Patten Eng. Co.
*Patten, Asher H.
W. E. Porter Co.
Porter, W. E.
Rio Grande Gravel Co.
Blose, Stanley
Schloss & Shubart
Schloss, Charles M.
Shelley, Leo D.
Shubart, Stanley C.
Siegrist Construction Co.
Zimmerman, M. Jordan
Southwest Potash Corp.
Waltman, Reid M.
Stearns Roger Mfg. Co.
Asel, Philip R.
*Barnard, Frank S.
Beech, C. S.
Borasio, Leo
Brither, Frank E., Sr.
Coyle, Sam D.
*Davidson, A. Jackson
Donaghy, C. P.
Druva, Robert L.
Graeber, Rowland W.
Hester, Walter B.
Irwin, Bruce H.
Mathews, Harvey
*McMichael, H. J.
McNeill, Harry L.
Monarch, Joseph L.
Olson, Ralph B.
Sproul, Archibald A.
Stryker, John R.
Sun Oil Co.
Justice, Philip S.
Thomas-Hyer Inc.
Hyer, J. W., Jr.
Thompson Creek Coal & Coke
Corp.
*Keenan, Albert M.
Tipton & Kahnbach Inc.
Duckworth, Maynard
Freeman, Alva O., Jr.
R. J. Tipton Assoc. Eng.
Naylor, John
Triton Oil Co.
Owen, William J.
U.S. Bureau of Mines
Bank, Walter
Bates, Robert C.
Bechtold, Charlotte A.
Boley, Charles C.
Connors, Hugh M.
Dare, W. L.
Denny, Edward H.
*East, John H.
Evans, Arthur M.
Jolley, Theodore R.

*Konselman, Albert S.
Rodriguez, Ernest R.
Schapiro, Paul P.
Shannon, Spencer S., Jr.
Shaw, John F.
Soule, John H.
U.S. Bureau of Reclamation
Wantland, Dart
U.S. Forest Service
*Willery, H. W.
U.S. Geological Survey
Alvord, Donald C.
Brobst, Donald A.
Chesebrough, S. A.
Cooper, John R.
Frisknecht, Frank C.
Hernon, Robert M.
Huff, Lyman C.
King, George V.
King, Robert U.
Lindeman, H. B.
Norton, James J.
Zablocki, Charles J.
U.S. Secur. & Exch. Comm.
Higdon, Charles E.
U.S. Treasury
Kunde, Marvin A.
Walbridge Co.
Walbridge, Cecil R.
O. W. Walvoord Inc.
Matthews, C. W.
*Walvoord, O. W.
Western Exploration & Management Co.
*Board, V. L.
Western Machinery Corp.
Jones, Leigh M.
Willey, Arthur R.
Willey, George M.
No Data Supplied
Barker, C. L.
Bigley, A. C.
Boos, Margaret F.
Brauns, Martin O.
*Campbell, T. P.
Cannaday, F. X.
Carlie, Jessie C.
*Carman, Katharine W.
Coffey, Robert C.
Coghlin, Will H.
*Congdon, Thomas E.
Cooper, Earl M.
Coulter, William J.
*Cramer, William B.
Daman, Arthur C.
De Castro, Alvaro
Derzay, Raymond C.
De Sollar, Terrence C.
Elmer, F. Robert
Evans, J. Claire
Fairchild, G. L.
*Fertig, Wendell W.
*Fominy, Michael P.
Foote, Royal S.
Frost, Hildreth, Jr.
Gebhardt, R. C.
Gordon, R. W.
Grove, Clark
Hodges, Wm. V.
Hollingsworth, J. S.
Hubbard, Judson S.
Johnson, O. H.
Jones, William R.
Korts, Ingraham V.
Loenhall, H. K.
Martin, Victor R.
Matthews, M. O.
McDaniel, W. R.
*McGarr, H. J.
Melting, A. C.
Moore, Thomas G.
Morgan, Helena O.
Mosier, A. G.
*Mosley, Herbert R.
Newcomb, Edward L.
Payne, Pearson M.
Payne, William L., Jr.
Pearson, Robert H.
Perry, L. L.
*Prommel, H. W. O.
Purdy, C. P., Jr.
Quinn, James E.
Ramsey, E. R.
*Ridland, G. C.
Rigg, John B.
Ritter, Etienne A.
Ross, Pat L.
Ruth, Joseph P., Jr.
Schipper, Warren B.
Spaulding, Edward C.
Studebaker, Jas. B.
Summers, Raymond H.
*Sweet, Arthur N.
Tedrow, Harvey L.
*Thomas, C. Sewell
Thomas, Lester C.
Thurrell, R. F., Jr.
Van Lewen, M. C.
Vickers, Rollin C.
Welker, Merrill
*Whitaker, Orvil R.
Wigton, Paul L.
*Willey, Clifford R.
Winans, G. D.

DURANGO

Vanadium Corp. of Amer.
Brinker, Fred A.
Edwards, Page L.
Viles, D. W.
No Data Supplied
Dorsett, Terry S.
Ferguson, John, Jr.
Wittmeyer, Wm. W.

EGNAR

No Data Supplied
Hankins, Terence J.

ENGLEWOOD

Dorr Oliver Inc.
Hughart, R. P.
Melin, Deering D.
Vucan Iron Works Co.
Hawn, C. W.
*Jett, John H.
No Data Supplied
Gray, Allen D.
Jameson, J. G.
O'Brien, Harvey P.
Robinson, Ernest G.

FAIRPLAY

No Data Supplied
Tiffany, James C.

FLORENCE

Fibreboard Paper Prod. Corp.
Comann, R. Kent

FORT COLLINS

Ideal Cement Co.
Wolfe, John A.
No Data Supplied
Gamba, Jerome F.
Heath, Robt. C.

FORT SMITH

Boyd Excelsior Fuel Co.
*Boyd, B. Degen

GATEWAY

No Data Supplied
Woodard, C. V.

GEORGETOWN

Barodynatics Inc.
*Livingston, Clifton W.

GILMAN

N.J. Zinc Co.
Brown, James M.
Fessenden, Paul H.
Jude, William L.
Merchant, John S.
Stienmiller, Harold
Williams, William B.
Wittauer, Foster J.
No Data Supplied
Langdon, Charles

GLENWOOD SPRINGS

Thompson Cr. Coal & Coke
*Allan, Andrew, Jr.
No Data Supplied
Cross, Bertram J.

GOLDEN

Amer. Metal Climax Inc.
Coolbaugh, Frank
Cuthbertson, Robert
Jones, W. E.
Colo. School of Mines
*Ayler, Maynard F.
*Badgley, Peter C.
*Baxter, Robert A.
Bench, Dan W.
Bloom, Harold
Bowdish, Frank M.
Brown, C. T.
*Bryner, Leonid
*Carpenter, Robert H.
Crabtree, E. H.
Davis, Franklin T.
*Fush, Charles O.
Gilbert, David R.
*Grosvenor, Niles E.
Guay, Willbur J.
Hildenbrandt, D.
Johnson, D. H.
Johnson, J. Harlan
Jones, John Moss
*Kohn, Truman H.
Link, James M.
Mariacher, Burt C.
Merritt, Robert C.
Parkinson, Lute, J.
Perry, J. Kent
Smith, Ross W.

*Vanderwilt, John W.
*Waldron, Howard L.
*Young, Thomas R.
Coor Porcelain Co.
*Meisel, George M.
CSM Research Fdn. Inc.
Franco, Horacio A.
Martin, Carl C.
*Smith, Fred L.
*Spence, Walter Christopher
*Svendsten, Paul V.
Kerr-McGee Oil Industries Inc.
Mattson, Vernon L.
Meyer, Gene
Melbye and Merwin
*Melbye, Charles E.
Norbut Corp.
*Deringer, DeWitt C.
No Data Supplied
*Anderson, Thomas Patrick
Bator, George T.
Bautista, Renato G.
*Bernstein, John
Bonham, Paul W., Jr.
*Carpenter, Clark B.
Elder, Robert L.
Haynes, C. V., Jr.
*Hopkins, Paul M.
King, Robert S.
Lange, Robert B.
Mateer, W. D.
Moston, Robert P.
*Parker, Ben H., Jr.
Portinga, Dale
*Short, Allan M.
Smith, Norman S.
Tyler, W. W.
*Wassar, Richard
*Warren, S. Power
Weinig, A. J.

GRAND JUNCTION

Argo Mining Co.
*Campbell, Lyle F.
Balboa Min. & Dev. Co.
*Stoick, Albert
Beaver Mesa Ura. Inc.
Simpson, Alan M.
Boomerang Mining Co.
*Woodard, Frank E.
Wm. J. Carey Mining Co.
Haynes, Harry E.
Century Geophysics Corp.
*Nicol, A. J.
Chapman & Morehouse
Mining Co.
*Chapman, John L.
*Morehouse, George B.
Climax Uranium Co.
*Donnerstag, Philip
*Duggan, E. J.
*Mastrovich, Anthony M.
Toerper, Ralph C.
Warner, Roland M.
Continental Materials Corp.
Brady, Maurice H.
Hopkins, Tad E.
Reynolds, C. H.
Roscoe, John G.
Dulane Mining Co.
*MacPherson, Frank H.
*Powers, Philip P.
First Nat'l Bank
Thomas, E. R.
Four Corners Uran. Corp.
*Clark, Edward Lee
Globe Mining Co.
Wyatt, Frank W.
LaSalle Mining Co.
Rowe, Matthew P.
Minerals Engineering Co.
*Burwell, Blair
*Sullivan, R. G.
Mitchell Drilling Co. Inc.
*Mitchell, John C., Jr.
*Mitchell, John C.
National Lead Co. Inc.
Beverly, Robert G.
N.J. Zinc Co.
Radabaugh, Robert E.
Norbut Corp.
Abbott, Charles
Pacific Uranium Mines Co.
Redmond, Robert L.
Shattuck Denn Mining Corp.
Newell, Thomas W.
Shipman & Flanders
Mining Co.
*Shipman, Mark K.
S & M Supply Co., Inc.
Monro, John T.
S & W Supply Co.
Son, D. G.
Sprague & Henwood Inc.
Carver, Robt. R.
Richards, Jacques (Jack)
Strategic Min. Exploration Co.
*Schumacher, John I.
Superior Oil Co.
Archer, Bryan J.
Barnard, Ralph M.
Gjelsteen, Thor
Wilpolt, Ralph H.

Texas-Zinc Minerals Corp.
Boyd, Arch F.
Hayes, A. L.
Union Carbide Nuclear Co.
Ary, T. S.
Brenton, J. F.
Burnett, John T.
Cohan, William T.
Emerson, John F.
Jackson, H. K.
Kohler, W. H.
Olson, Richard H.
Perry, Albert J.
Seidel, Don C.
Van Fleet, Thomas R.
Van Zante, Roy D.
Wharton, Heyward M.
U.S. Atomic Energy Comm.
Anderson, Edwin E.
Baker, David D.
Barnes, J. W.
Blair, Robert G.
Brown, Durrel L.
Brown, Gordon T.
George, D'Arcy R.
*Hill, Don R.
Hutchinson, W. S., Jr.
King, John W.
Lekas, Mitchell A.
Mayer, Stanley A.
Patterson, John A.
Phillippon, Richard L.
Razor, Charles A.
Ritter, Gilman C.
Toole, R. H.
Toren, T.
Winn, Burdett A.
Youngberg, Elton A.
U.S. Geological Survey
Hasler, J. William
Western Machinery Co.
*Setter, A. George
Ferron, Robert A.
White Canyon Mining Co.
*Malot, Frank J.
Worcester Mines
Hill, John W.
Poister, C. E.
No Data Supplied
Anderson, L. D.
*Barry, John G.
Beck, Richard H.
Bemis, F. A.
Combs, John X.
Conklin, Quentin E.
*Cutter, Russell C.
Daniel, Robert B.
Dearth, Albert E.
Fulton, David H.
Gaggini, Louis P.
Gammell, Robt. M.
Haldane, W. J.
Hartmann, Burt E.
Henderson, James G.
Hofman, D. E.
Holmes, Thomas W.
Illsley, Chas. T.
Janakka, W. E.
Jarvis, James D.
Jones, A. E.
Lake, James L.
Lewis, Elbert E.
Lindblom, R. A.
Mehan, M. P.
*Mizelle, Ed.
*Muir, Neal M.
*Newlove, M. E.
*Orear, Neilson B.
Pinnick, Edgar K.
Redman, Travis H.
Richards, B. S., Jr.
*Robeck, Raymond C.
*Robison, John L.
Rummel, G. T.
Sharp, John W. A.
Simpson, Julian E.
Sterns, Clarence C.
Tanne, Verne J.
Vandenberg, J. R.
Weston, J. E.
Wright, Warren E.
Young, Thomas W.

GRAND VALLEY

Energy Resources Inc.
*Erl, Tell
Union Oil Co. of Calif.
Ball, Frank C.

GUNNISON

Gunnison Mining Co.
Green, William R.
*McAlexander, R. M.
Pinnacle Exploration Inc.
Baker, Arthur, III
Dunn, James E.

HOTCHKISS

No Data Supplied
Ellis, Scott

IDAHO SPRINGS

Jack Pine Mining Co.
Watrous, Douglas V.

LAKEWOOD

No Data Supplied
Akal, Yalcin
English, G. L.
Hemley, J. Julian
Masbruch, Arthur C.
Russell, Donato L.

LEADVILLE

American Smelt. & Ref. Co.
*Cohenour, Quintin M.
State of Colorado
Kendrick, Frank E., Jr.
No Data Supplied
Crosby, James
Foster B. R.
Kleff, J. Marvin
Kendrick, Robert
Saunders, James B.

LITTLETON

Ohio Oil Co.
*Lickus, Robert J.
Pray, Lloyd C.
No Data Supplied
Byerrum, Jack B.
Detrick, Walter S.
*Dickinson, George W.
Johnston, T. L.

MAYBELL

Union Carbide Corp.
Guilinger, Robert R.
Temple, Frank T.
Thompson, Robert M.

MONTROSE

Doyle, Wm. R.

NATURITA

Naturita Supply Co., Inc.
Wenzel, R. O.
No Data Supplied
Clark, Henry D.

OURAY

Idarado Mining Co.
*Graves, Clarence E., Jr.
Wise, John S.
No Data Supplied
Gunselton, Adolph G.

PALISADE

Meek, Ward B.
Rohlf, O. D., Jr.

PALMER LAKE

U.S. Air Force Academy
*Campbell, Gilbert L.

PAONIA

No Data Supplied
Thornburg, Vance E.

PUEBLO

Colo. Fuel & Iron Corp.
Berthoff, W. M.
Carter, David A.
Christy, Harold H.
Erickson, Reed G.
Jackson, Robert A.
Johnson, Robert N.
Kalish, Philip
Malwitz, Dennis G.
Price, John D.
Purdy, John R.
Schenler, W. J.
No Data Supplied
Blalock, Clovis C.
*Taylor, Leslie S.

RICO

Rico Argentine Mining Co.
Birch, L. B.
Forest, Robert T.

RIFLE

Union Carbide Nuclear Co.
*Chandler, John M.
Mates, Robert R.
No Data Supplied
Lawson, Theodore J.
Strom, Elwood E.

SOLIDA

Colo. Fuel & Iron Corp.
Whitney, James E.
Omni-Metals Inc.
*Burleson, Walter E.
No Data Supplied
Murphy, John A.
Thurber, H. K., Jr.

SILVERTON

Old Hundred Gold Mng. Co.
*Sandell, W. G.
No Data Supplied
Andreatta, R. M.

SLICK ROCK

Union Carbide Nuclear Co.
Foss, Harold
Riddle, John A.
Sawyer, Carl W.
Witt, Wilmer H.
No Data Supplied
Jones, Robert B.
Sander, John P.

TELLARIDE

Idarado Mining Co.
*Cole, David R.

TRINIDAD

No Data Supplied
Bowie, William K.

URAVAN

Omni-Metals Inc.
*Sayre, Robert H., Jr.
Union Carbide Nuclear Co.
*Bebe, Alfred H., Jr.
Borden, James R.
Hastings, James S.
Hays, Thomas Mack
Heinz, John M.
Lankenau, Arthur W.
Sada, A. C.
Scott, Marshall W.
Stolk, Willem F. A.
Swindle, Roger W.
No Data Supplied
Thompson, Arthur C.

VICTOR

Golden Cycle Corp.
*Klein, William C.

WESTON

Colo. Fuel & Iron Corp.
Ingles, Lloyd W.

WHEATRIDGE

No Data Supplied
Croy, Robert E.
Lagergren, M. A.
*Simpson, Robert E.

CONNECTICUT

BRIDGEPORT

Bridgeport Public Lib.
Sohon, Julian A.
General Electric Co.
Benson, C. Gordon
Handy & Harman
Leach, Robert H.
Remington-Rand Corp.
Lord, James

COS COB

No Data Supplied
Christie, D. J.

DANBURY

American Cynamid Co.
Kaufman, David
Newmont Exploration Ltd.
Baldwin, Robert W.
Bechaud, L. J., Jr.
Brant, Arthur Albert
Elliot, Charles L.
*Hellyer, Walter C.

DARIEN

No Data Supplied
Chambers, F. W.
Furbank, A. W.
Goodwin, Walter L.
*Hoyt, John Terrell

EASTON

No Data Supplied
Parkinson, R. W.

GREENWICH

Amer. Machine & Fdry. Co.
*DeKanski, Leon M.
North Castle Books
*Nichols, Herbert L., Jr.
No Data Supplied
Engelhardt, Allen H.
Myers, John F.
Townsend, Rex
*Twitchell, Karl S.

HAMDEN

No Data Supplied
McGraw, Robert B., Jr.
Young, Wallace

HARTFORD

Hartford Electric Steel Corp.
Jacob, Walter F.

LAKEVILLE

Nutmeg Mining Corp.
Levine, Arthur F.

LYME

No Data Supplied
Harding, James E.

MADISON

No Data Supplied
Shepherd, Owen

MERIDEN

John S. Lane & Son Inc.
Moore Milton D., Jr.
No Data Supplied
*Egeberg, B.

MIDDLETOWN

Wesleyan Univ.
Peoples, J. W.
No Data Supplied
Craig, Howard R., Jr.

NEW CANAAN

No Data Supplied
Caron, Peter E.
Copeland, Garnet G.
Lourie, D. E.
Monroe, E. H.

NEW HAVEN

The Box Shop Inc.
Behre, Henry A.
A. N. Farnham Inc.
Kolb, Thomas T.
The New Haven Trap Rock Co.
*McKeagney, Robert B.
Yale University
*Bateman, Alan M.
*Cotton, John E.
*Jensen, Mead LeRoy
*Milligan, William E.
No Data Supplied
Burns, William

NEW MILFORD

The Warner Collieries Co.
Marshall, Carl A.

NOROTON HEIGHTS

No Data Supplied
Neale, Walter G.

ORANGE

No Data Supplied
Chester, Paul L.
Graton, L. C.

RIDGEFIELD

No Data Supplied
Hartjens, H.

RIVERSIDE

No Data Supplied
*Walker, Godfrey B.

SHARON

No Data Supplied
Spencer, Frank N.

SHELTON

No Data Supplied
Zaskalicky, M. E.

SOUTH KENT

No Data Supplied
Linz, Paul

SPRINGDALE

Time Inc.
Mulford, Frank C.
No Data Supplied
McClean, Daniel C.

STAFFORD SPRINGS

Linatex Corp.
Jackson, A. B.

STAMFORD

American Cynamid Co.
Booth, Robert B.
Farwell, Fred W.
Hedley, Norman
Kennedy, James S.
Tabachnick, Howard
Dorr-Oliver Inc.
Ansible, Anthony
*Barnebi, A. C.
Bauer, Hans A.
Chase, Charles H.
Clemens, Robert F.
Eng, Philip B.
*Grothe, J. D.

Hitch, J. Delano, Jr.
Hitzrot, Henry Wm.
Hochscheid, Robert E.
*Jukkola, W. W.
Love, George A.
Marston, W. T.
Mason, W. Clark
McArde, Robert J.
Michener, John W.
Munro, Neil
Priestley, Robert J.
*Reynolds, Victor R.
Roberts, Elliott J.
Schreiber, Charles A.
Smith, Wm. E.
Stansmore, Keith C.
Terry, A., Jr.
Thompson, Robt. B.
*Westphal, Carl W.
*Weber, Wm. C.
Wilson, G. O.
Woob, Thomas

Hewitt Robins Inc.
Goodyear, Austin
Speaker, Francis B.
*Von Thaden, Harold
No Data Supplied
Aries, Robert S.
Dobson, John M.
Lindstrom, K. C.
Maloney, J. J., Jr.
*McLeod, Bentley H.

SHUFFIELD

No Data Supplied
Crawford, Bruce D.

WATERBURY

The Bristol Co.
Heslin, Gerald M.
Chase Brass & Copper Co.
Preston, William H.

WESTBROOK

No Data Supplied
Spencer, E. A., Jr.

WESTON

No Data Supplied
Bregy, Louis H.

WESTPORT

Dorr-Oliver Inc.
Bosqui, F. L.
Nauta, Robin G.
Oliver, Robert H.
Wall, Clarence J.
No Data Supplied
Beckwith, Alfred T.
*Darby, George M.
Foley, Rupert M.

WILTON

No Data Supplied
Ellingsen, Robert L.

WOODMONT

No Data Supplied
Bronkie, Willis F.

DELAWARE

CLAYMONT

Colo. Fuel & Iron Corp.
Smith, Hubert C.

NEWARK

No Data Supplied
Krejt, Milo W.
Rousselle, Jean E.

Colorado-District of Columbia

WILMINGTON

Atlas Powder Co.
Barnes, John G.
Colson, Max E.
Dedman, James E., Jr.
Gottshall, Ralph K.
Hutcheson, Allen F.
*Jeffries, John M.
McCarron, John F.
McCutchen, Dan
McFarland, D. M.
McGuinness, A. L.
Romig, John L.
Sanders, Marshall T.
Thompson, D. A. R.
E. I. Du Pont de Nemours & Co.

Berry, Charles E.
Dana, Edmund L.
Evans, Clarence H.
Fowler, Eldridge M.
Fulton, Robt. B., III
Gallant, Raymond B.
Gillson, Joseph L.
Crogan, Robert M.
Henry, R. P.
Irvin, Melvin
Jerman, Theodore I.
Jones, Albert A.
Parrott, F. W.
Platt, Kenneth B.
Poel, Harlan J.
Pomeroy, Chester M.
St. Peter, Albert L.
Temple, Alan K.
Wieland, Carson E.
Wise, Leonard G.

The Explosives Engineer
Horty, Joseph I.
Hercules Powder Co.
Ballard, C. W.
Bishop, W. T.
Budd, M. R.
Crabtree, R. W.
Dowling, Jerry C.
Forster, A. E.
Hammond, Philip R.
Hayes, Jack D.
Hurley, Lawrence F.
Kelleher, J. Joseph
Martin, John M.
Ryan, John R.
Schindler, J. H., Jr.
The Pyrites Co. Inc.
Trumbull, R. Arr
Wilson, Alex G.
No Data Supplied
Campbell, Dolph
Conn, Doak O.
Govatos, John N.
Hoskins, Ben B.
Reinhart, Walter L.
Seibert, Kenneth T.

DISTRICT OF COLUMBIA

Am. Geological Inst.
*Stephenson, Robert C.
Am. Mining Congress
Conover, Julian D.
Jackson, Glenn F.
Sall, George W.
VanEvert, Robert W.
*Whiting, Jerry M.
Am. Smelting & Refin. Co.
Newhouse, Edgar L., III
Am. Trucking Assoc. Inc.
*King, Samuel M.
Am. Perlite Co.
*Maury, Jesse L.
Bituminous Coal Inst.
Hardy, Carroll F.
Helt, Wilbur C.
Reese, John F.
Bituminous Coal Operators' Assn.
*Fox, Edward G.
Trevorrow, George C.
Chamber of Commerce of the U.S.
Smith, Richard W.
Chambre Syn. de la Siderurgie
Scherschewsky, P. L.
Export-Import Bank of Washington
DeCelles, Arthur E.
Rutledge, Franklin A.
Geo. Surveys
*Meyerhoff, Howard A.
Ingersoll Rand Co.
Kennedy, John J.
Joy Mfg. Co.
Lee, Arnett J.
Allen Kander & Co.
*Grimes, John Alden
Mechanization, Inc.
Coombs, Russ
*McCurdy, Wayne A.
Nat'l. Academy of Sciences
*Keiser, H. D.
National Coal Assn.
Campbell, Robert F.
Nat'l. Crushed Stone Assn.
Gray, J. E.

District of Columbia-Florida

Nat'l. Sand & Gravel Assn.
Walker, Stanton
Nat'l. Slag Assn.
*Bauman, Edward W.
Porter International Co.
Hart, Franklin A.
Potash Co. of America
Billings, Robert G.
Resources for the Future, Inc.
*Netschert, Bruce C.
Resources Research, Inc.
*McCabe, Louis C.
So. Coal Producers Assn.
*Benson, J. B.
So. Railway System
*Shuffelbarger, Thomas E., Jr.

U.S. GOVERNMENT

Atomic Energy Commission
Faulkner, Rufford L.
*Hamburger, Richard
Johnson, Jesse C.
Lennemann, Wm. L.
Nininger, Robert D.
Sherman, John T.
Storm, Howard
Upchurch, Thos. B.
Bureau of Indian Affairs
Caldwell, David L.
Wyner, Alexander S.
Bureau of Mines
*Gakner, Alexander
Allsman, Paul T.
Ankeny, Marling J.
Baroch, Charles J.
*Callaway, Harry J.
Chandler, Henry P.
Creutz, William L.
DeHuff, Gilbert L., Jr.
*Dierks, Henry A.
Dupuy, Leon W.
Ellerton, Donald E.
Gottlieb, Sidney
Gwinn, G. Richards
Hamer, Paul D.
Hill, James E.
Hosted, Joseph O.
Irving, Donald R.
Iverson, H. G.
Johnson, John A.
Josephson, G. W.
Key, Wallace W.
Kuster, W. V.
Lamb, Frank D.
Larson, Leonard P.
Lewis, Walter E.
McGann, Paul W.
Miller, Thomas H.
Monteith, B. M.
Nahai, Lotfolah
Noe, Frank E.
Perry, Harry
*Price, E. R.
Reno, Horace T.
Rice, Wm. E.
Ryan, J. Patrick
Schreengost, H. A.
Schreck, Albert E.
Scollon, T. Reed
Siak, Amphis D.
Sokoloff, V. P.
Turnbull, Louis A.
*Wang, Kung-Ping
Weaver, Harry F.
Wessel, F. W.
Yones, Paul
Zinner, Paul
Dept. of Agriculture
Swigart, Charles
Dept. of the Army
Benecke, Robert E.
Haley, Ralph
*Watkins, Vernon L.
Weigle, David J.
Whitla, Raymond E.
Dept. of Commerce
Hughes, H. Herbert
*Lintner, Edwin J.
Minister, Percy F.
Dept. of the Interior
Ching, Michael
Hardy, Royce A.
Holt, Stephen Philip
*Houk, Lawrence G.
*Knouse, Frederick L.
*Lasky, Samuel G.
*McCormick, Robert B.
*Moulds, Donald E.
*Murphy, Fred M.
*Plein, Leo N.
Selfridge, George C.
*Shafer, Wm. L.
Stott, Roy G.
Dept. of the Navy
*Barlow, Wallace D.
Dept. of Internal Revenue
Hill, John F.
McGinnis, Russell C.
Dept. of the Treasury
Repass, Merle M.
Federal Aviation Agency
Brandenburg, O. L.
Federal Power Comm.
Balderson, Vearle W.

Gen. Services Adm.
*Brussolo, V. A.
Croston, John
Fredell, Clarence A.
Maday, Donald S.
Ward, James B.
Wilson, R. E.
Geological Survey
Abernethy, D. Carl
Anderson, Charles A.
Bannerman, Harold M.
Birdsall, John M.
Brackett, William R.
Brown, Andrew
Drake, Avery A., Jr.
Eric, John H.
Fulton, Robert S.
Guild, Philip W.
Harrington, Jos. F.
Hooker, Marjorie
Kinkler, Arthur R., Jr.
Kirkemo, Harold
Klepper, Montis R.
Lang, Walter T. B.
Larrabee, David M.
Lewis, Richard W., Jr.
Mattila, Arne A.
Nelson, Ned E.
Newman, William L.
Nolan, Thomas B.
Reed, John C.
Reeves, Robert G.
Rogers, Cleaves L.
Schaller, W. T.
Stuart, Wilbur T.
Turner, J. D.
*Waesche, Hugh H.
Wrathner, William Embry

Int'l. Coop. Adm.
Allen, C. W.
DeChetelat, Enzo
Lockwood, Benomi, Jr.
Securities & Exchange Comm.
Adelstein, Benjamin
Senate
Smith, H. A.
Tariff Comm.
*McBrian, Joe
*Wright, William E.
World Bank
*PrudHomme, Hector
Unidentified U. S. Gov't.
Bowers, William A.
Flynn, George J., Jr.
Grant, Robert Y.
Klugescheid, W. P.
North, Oliver S.
Richardson, G. R.
Smith, A. Leonard
Warner, Robert K.
Williams, J. Fred, Jr.
Wilmot, Richard C.

No Data Supplied
Bradbury, Wm.
Burdick, Charles A.
Carpenter, M. H.
Chapman, Edward P.
Davitt, William H.
Dickinson, Albert W.
Ferguson, Henry G.
*Fieldner, Arno C.
Fraser, T.
Gealy, Edgar J.
Herzog, Emanuel
Johnson, Charles H.
Johnson, Frank E.
Jones, Daniel A.
Juhre, Charles C.
*Kessen, George Harold
Larsen, Esper S., Jr.
Lattimore, Robt. K.
Leonard, F. Morton
Lytzen, W. W.
Malone, George W.
Martin, Thomas E.
Martin, W. S.
McPherson, James D.
Merrill, C. W.
Miller, Robert B.
Moore, Perry N.
Moran, Louis F.
*Morgan, John Davis, Jr.
Morris, Henry C.
*Murphy, Paul R.
Neal, Homer C.
Parker, Glen L.
Pehrson, E. W.
Roosevelt, C. V. S.
Sayers, R. R.
Schultz, W. W.
Sears, Stanley Collamore
*Smith, Cloyd M.
Smith, Herbert W.
Smith, Howard I.
Tally, O. V.
Webb, Wm. Y.
*Wright, Charles Will

FLORIDA

BARTOW

Am. Cyanamid Co.
Haynsworth, E. M.
Armour Fertilizer Works
Hedrick, Harold N.

Davidson Chem. Co.
*Murphy, A. H., Jr.
Olsen, Clarence G.
W. R. Grace & Co.
Elliott, Fernley H.
Frost, Alexander J.
*Greene, Charles H.
Jones, Bennie P.
Wallom, David E.
Int. Min. & Chem. Corp.
*Barbarowicz, Wm.
*Barnett, John C.
Cross, William C.
Feigin, Harry M.
Frye, J. Laurence
Garcia, Raymond G.
Giles, Claud B.
Guffey, A. A.
Guy, Richard D.
Hahn, Allan J. P.
Hail, Jephtha R.
McClintock, Walter O.
Roe, James F.
Smith, Matthew T.
Wunsch, Phil G.
Frank M. Murphy & Assoc.
*Houston, Wesley M.
Polk Equipment Co., Inc.
Becker, John N.
Booram, J. W.
Rubbercote, Inc.
*Safford, Robert V.
Swift & Co.
White, Frank E.
Wellman-Lord Engrg. Inc.
*Casler, E. T.
No Data Supplied
Abbitt, James M.
Bowen, Floyd B.
Byrum, A. S.
Chavasse, N. H.
Cooper, Howard F.
Ellis, Edward J.
Fenske, Douglas H.
Fox, Harold F.
Haarmann, H. A.
Hardy, Harvey B.
Loehr, H. T., Jr.
Lynch, Dan H.
Martinsack, M. V.
*Mayberry, Richard C.
McArthur, Milton P.
McLaulin, Doug F.
McMullen, Donald
Pamplin, John W.
Pierce, E. A.
Raulerson, J. D., Jr.
Taylor, Don L.

BRADENTON

No Data Supplied
Connor, Charles W.

BREWSTER

Am. Cyanamid Co.
Brice, Charles D.
Cheeson, Maywood W.
Childs, W. B.
Crago, Arthur
Custred, U. K.
McCrory, R. J.
*Patterson, Thomas J.
Watkins, S. Clyde
No Data Supplied
Lassiter, M. S.
Saunders, Robert N.
Weaver, J. L.

CLEARWATER

No Data Supplied
Clark, Robert J.
*Johnson, Herbert B.

DELAND

No Data Supplied
Hall, C. W.

GOLDEN BEACH

No Data Supplied
Kuryla, M. H.

CORAL GABLES

No Data Supplied
Ahbe, Frederic R.

CRESCENT CITY

No Data Supplied
Largent, Neely C.
*St. Clair, Stuart

CRYSTAL RIVER

M. J. Colitz Co., Inc.
Colitz, Michael J.

EAU GALLIE

Duffey Engrg. Inc.
*Duffey, John I.

EDGAR

Edgar Plastic Kaolin Co.
Davis, George E., Jr.

FERNANDINA BEACH

No Data Supplied
Miller, Elwood A.
Quirk, Richard
Roberts, Edw. N.

FT. LAUDERDALE

No Data Supplied
Lednum, E. T.
Lentz, Gene

FT. MEADE

No Data Supplied
Barnett, Dave H.

GAINESVILLE

Univ. of Florida
*Reichert, Stanley O.

GREEN COVE SPRINGS

Fla. Solite Corp.
*Pace, Charles R., Jr.

GULF BREEZE

No Data Supplied
Steck, Charles E.

HOBE SOUND

No Data Supplied
McConnell, Robt. E.

HOLLYWOOD

Mack Industries, Inc.
*Miller, Fred A.
No Data Supplied
Petrovsky, W. J.
Sawitzke, Ed.

JACKSONVILLE

Carpco Res. & Engrg. Co.
*Barthelemy, R. E.
*Carpenter, J. Hall
*Dyrenforth, William P.
Humphreys Gold Corp.
Beebe, E. S.
Siprelle, W. J.
*Weichel, E. C., Jr.
*Whittle, Eugene V.
Wood, Jay F.
No Data Supplied
*Dyrenforth, Donald
Payne, C. E., Jr.
Strange, Charles H.

LAKELAND

Harry B. Cannon Assoc.
*Cannon, Harry B.
Allen T. Cole & Assoc.
*Cole, Allen T.
M. R. Creasy Co.
*Creasy, M. R.
Leap Assoc. Inc.
*Hill, Roy N.
Stevens Assoc. & Co.
*deStefano, M. C.
Wellman-Lord Engrg. Inc.
*Sikora, E. S.
No Data Supplied
Abercrombie, Harry W.
Clifton, Bernarr
Cox, James L.
Decker, Frank C.
Fort, W. R.
Hatch, John F.
Hopkins, Robert H.
Lawyer, James E.
Lyle, Geo. L., Jr.
Mills, C. E.
Northcott, E., II
Permenter, J. C., Jr.
Purcell, E. J.
Robeson, David H.
Stevens, P. S.
Uhlend, H. E.
Wood, L. G.

LIVE OAK

Live Oak Stone Co.
Blake, Daniel

MIAMI

Oolite Crushed Stone Co.
Harrington, Leroy J.
No Data Supplied
Brown, W. T.
Hoover, Ray P.
Lanigan, Joseph
Robinson, H. S.

MULBERRY

R. H. Clark Equip. Co.
Heathman, E. S.
Jensen, T. J.
Fla. Conveyor & Equip. Co.
*Kain, Arthur F.
Int'l. Min. & Chem. Corp.
Haseman, Joseph F.
Kauffman, Robert D.
*Watt, Stuart G.
Oak Ridge Sand Co.
Bergquist, Richard B.
No Data Supplied
Carter, W. F.
Hewett, L. F.
Wiggins, V. J.

NAPLES

No Data Supplied
Price, J. M.

NEW PORT RICHEY

No Data Supplied
*Jones, Jack O.

NICHOLS

Va. Carolina Chem. Corp.
Chapman, O. Charles
Dean, Arnold W.
*Hughes, C. V. O., Jr.
Pascoe, Hubert Leonard

ORLANDO

No Data Supplied
Deal, Troy M.
Heoman, Carl
Lauer, H. H.

ORMOND BEACH

No Data Supplied
Lee, Oscar

PANAMA CITY

No Data Supplied
Kirkland, C. J., Jr.

PENSACOLA

No Data Supplied
Holland, A. A.

PIERCE

Am. Agricultural Chem. Co.
Berquist, F. R.
Breathitt, Harvie W.
Faulds, N. Morris
Gruel, John S., Jr.
Quina, Herbert R.

PLANT CITY

Coronet Phosphate Co.
Stockton, Robert J.
Wester, J. L., Jr.
Smith Douglas Co. Inc.
Hollingsworth, Clinton A.
Wayne Thomas Inc.
*Thomas, Wayne
No Data Supplied
Martinez, Federico
Nagel, William A.

ST. AUGUSTINE

No Data Supplied
Archibald, Little
Ponton, Gerald M.

ST. PETERSBURG

R. C. Huffman Const. Co.
*Clarke, William J.
No Data Supplied
Bogert, John R.
Deane, Elbridge Gerry
*Roehm, John C.
Stollings, G. J.
Trotter, Arthur H.
Uhle, T. T.
Wiggins, Ralph R.

SARASOTA

No Data Supplied
Amontree, Burton
*Remick, Walter L.
*Sunday, W. Edward

STARKE

E. I. du Pont Co.
Ruffini, John A.
Sutton, Harold L.

TALLAHASSEE

Arrowhead Geoservices
*Orsborn, James T.

Coastal Petroleum Co.
 *Bates, John D.
 Florida Geol. Survey
 *Vernon, Robert O.
 Florida State Univ.
 *Buie, Bennett Frank

TAMPA

Svend A. Canaris
 *Canaris, S. A.
 Pat Flanagan Inc.
 Horton, A. Lee
 Port Sutton Inc.
 *Thomas, Robert
 U. S. Phosphoric Prod.
 Lowzow, Odd
 No Data Supplied
 *Fiedler, Harry L.
 Mead, H. L.

VERO BEACH

No Data Supplied
 *Kanowitz, S. B.
 Metz, Gilbert F.

WEST PALM BEACH

Air Products Inc.
 *Antaki, Victor N.

WINTER PARK

No Data Supplied
 O'Neil, F. W.

GEORGIA

ATLANTA

Dorr-Oliver Inc.
 Johnston, Irwin J. W.
 Ullmer, Robert J.
 Georgia Dept. Mines & Geology
 Peyton, Garland
 Georgia Inst. of Tech.
 *Fortson, Charles W., Jr.
 *Husted, John E.
 Mitchell, Lane
 Sprague & Henwood Inc.
 Fletcher, Kevin A.
 No Data Supplied
 Cronheim, Samuel P.
 Geyer, Robert F.
 Hume, J. N.
 Mitchell, Bruce L.

ATTPULGUS

Minerals & Chem. Corp. of
 Amer.
 Fedler, Albert H.

AUGUSTA

No Data Supplied
 Garris, W. V.

BLUE RIDGE

No Data Supplied
 Rockwell, F. E., Jr.

CARTERSVILLE

Thompson, Weinman & Co.
 Beavers, G. W.

CHATSWORTH

Southern Talc Co.
 *Glenn, M. Woodard

DECATUR

Consolidated Quarries Corp.
 Severinghaus, Nelson

DONALSONVILLE

No Data Supplied
 Kminek, John M.

DRY BRANCH

Ga. Kaolin Co.
 Fargason, David J.

FORT BENNING

U. S. Army
 Byrum E. Oliver

GORDON

Southern Clays Inc.
 *Auvil, Jesse H., Jr.
 Scott, John W. M.

GRAY

Weston & Brooker Co.
 Castleberry, Douglas

LUMPKIN

No Data Supplied
 Hunt, Lee, M.

MCINTYRE

Edgar Bros. Co.
 Todd, A. G., Jr.

MACON

Burns Brick Co.
 Burns, Henry K., Jr.

MARIETTA

Georgia Florida Drilling Co.
 *Willingham, Charles B.

MONTICELLO

No Data Supplied
 *Burgess, Blandford C.

SANDERSVILLE

No Data Supplied
 Carlson, Roger M.

SAVANNAH

American Cynamid Co.
 Hladky, Emil

SEA ISLAND

No Data Supplied
 *Summers, Milo Whitney

TATE

Georgia Marble Co.
 Severinghaus, Nelson Jr.
 *Zibell, J. Scott
 Smith, W. L.

THOMASVILLE

Dawes Silica Ming. Co.
 Pierson, Richard E.

HAWAII

HONOLULU

Hawaiian Sugar Planters Assn.
 Cox, Dock C.
 No Data Supplied
 Castle, S. N.
 Ching, Larry F.

IDAHO

ALAMEDA

No Data Supplied
 Henriksen, A. J.

BAYVIEW

Conjecture Mine
 Drips, Robert C.
 Federal Uranium Corp.
 Campbell, Walter N.

BOISE

Barton-Stoddard & Milhallen
 *Barton, Sherwin M.
 Bunker Hill Co.
 McRae, Robert J.
 Butler Engr. Assoc.
 *Butler, T. C., Jr.
 Hermada Mining Co.
 *Oberhillig, Ernest
 Idaho Dept. of Highway
 Mahon, Scott
 Idaho Mining Assoc.
 Marsh, Harry W.
 Intermountain Equip. Co.
 Dufford, Philip A.
 Porter Bros. Corp.
 Lothrop, Robert A.
 Talache Mines Inc.
 Burroughs, A. H., Jr.
 Whalen & Co.
 *Whalen, Jerry F.

No Data Supplied
 Bikerman, Michael
 McFarlane, J. C.
 *Moore, David L.
 Moore, Wesley J.
 Smith, Gordon C.
 Stoddard, Bruce W.
 *Wagner, Warren R.

BONNERS FERRY

No Data Supplied
 Goodrich, James P.

COBALT

Calera Ming. Co.
 Braden, Howard H.
 Cole, William C.
 Douglas, Edwin B.
 Minerman, Roger L.
 Wilson, Thomas L.

COEUR D'ALENE

City of Coeur d'Alene
 *Brownson, Lloyd D.
 No Data Supplied
 Garber, C. Y.
 Langston, A. E.
 Norman, Hubert W.

EMMETT

M. L. Pate
 Martin, John W.

IDAHO FALLS

G. E. Co.
 Mann, Robert C.
 No Data Supplied
 Cuthbert, Gary R.

KELLOGG

Bunker Hill Co.
 *Baker, Douglas
 *Bethune, A. Y.
 *Bracken, Everett O.
 *Cote, Ralph W., Jr.
 *Craig, John Gordon
 Easton, Stanley Alexander
 Gordon, Joe E.
 Griffith, LeVern M.
 Hammerand, V. F.
 Kirkpatrick, K. K.
 *Klobusicky, Tibor
 Mahoney, B. F.
 McConnell, Roger H.
 McCulloch, G. J.
 Nugent, Alfred E.
 Olds, Edward B.
 Park, M. A.
 Prindle, Fred L.
 *Rudys, Joseph F.
 *Sather, Norman J.
 *Tapper, Thomas M.
 *Younger, James A.
 Marr Lease
 Marr, Frank N.
 *Redding, Curtis F.
 Sidney Ming. Co.
 Brown, Malcolm C.
 *McKinley, C. A.
 Sunshine Ming. Co.
 *Colson, James B.
 *Durham, James C.
 Johnson, H. Bradley
 McKinnis, William B.
 Sharp, Franklin H.
 No Data Supplied
 Jaaberg, O. J.
 McDougall, S. W.
 Mize, Robert J.
 Muhs, Robert A.
 Nash, Albert Marvin
 Preston, K. L.
 Routon, Donald E.
 Russell, Robt. L.
 Scanlon, Robert H.
 Tallmadge, K. A.

KINGSTON

No Data Supplied
 Butler, John N., Jr.

LEWISTON

No Data Supplied
 Young, Austin L.

MCCALL

Cal-Creek Placer, Inc.
 Evans, Mark

MONTPELIER

Central Farmers Fertilizer Co.
 *Hand, David
 No Data Supplied
 Gaynor, Thomas E.
 Wilson, Francis L.

MOSCOW

J. R. Simplot Co.
 Peterson, Phillip T.
 Univ. of Idaho
 *Cook, E. F.
 Newton, Joseph
 Prater, Lewis S.
 *Staley, W. W.
 No Data Supplied
 Crosby, James W.
 Crosby, Robert E.
 *Fahrenwald, A. W.
 *Williams, Robert S.

MULLAN

Lucky Friday Silver Lead
 Mines Co.
 Featherstone, Wray

OSBURN

Hecla Min. Co.
 Campbell, Thomas D.
 No Data Supplied
 Randall, Wallace
 Dickerson, Ben F.
 Rice, Robt. A.
 Simos, John G.
 Woodard, William R.

PLACERVILLE

No Data Supplied
 Prebble, Bert

POCATELLO

Food Mach. & Chem. Corp.
 Fowler, Heath B.
 Hayden, Russell J.
 Heim, George W.
 Howard, Richard I.
 Lowry, John W.
 Martin, George Wm.
 Rooney, F. S.
 Vincenz, Kenneth C.
 Young, W. A.
 J. R. Simplot Co.
 Clouser, John F.
 Hill, Robert B.
 Kilbourne, W. Grant
 Pothier, O. Edward
 No Data Supplied
 Scardino, James J.
 Willey, Stephen F.

ST. MARIES

No Data Supplied
 *Walker, Pierce C.

SALMON

No Data Supplied
 Oref, Wallace R.

SHOSHONE

No Data Supplied
 Oneida, Frank A.

SODA SPRINGS

Montanto Chem. Co.
 Atwood, George L.
 Crouse, Russell H.
 Gardner, Sherman D.

TROY

A. P. Green Fire Brick Co. of
 Idaho
 Buchan, M. A.

WALLACE

Amer. Smelt. & Refin. Co.
 Deshler, George A.
 Dorman, K. Robert
 Gordon, Robert G.
 Haeseler, A. E.
 Kesten, S. Norman
 Kieffer, J. C.
 Kupach, Robert J.
 Melcher, Milton A.
 Pettit, Robert F., Jr.
 Vines, Norman
 Zelenkov, Sergei
 Clayton Silver Mines
 *Smith, Norman M.
 Coeur d'Alene Hdwe. & Fdry.
 Co.
 Austin, Robert B.
 Day Mines Inc.
 *Crosby, Garth M.
 Day, Henry Lawrence
 *Farnin, Rollin
 *Miller, Philip R.
 *Sparks, Carville E.
 Hecla Min. Co.
 Anderson, William Jr.
 Bell, J. Douglas
 Davis, Robert B.
 Hunter, James H.
 Love, W. H.
 Rice, Gary B.
 Sorensen, Arthur Halvor
 *Sorensen, Robert E.
 Idaho Dept. of H'ways.
 Kimes, Dale K.
 Lucky Friday Silver-Lead
 Mines Co.
 *Folwell, William T.
 No Data Supplied
 Finley, James D.
 Grant, Lewis A.

Florida-Illinois

Gyde, James F.
 Hornman, R. J.
 Lynch, Harold C.
 Shook, Herbert H.
 Vaughan, Everett E.

YELLOW PINE

Profile Tamarack M. Co.
 *Abstein, Henry T.

ILLINOIS

ALEDO

No Data Supplied
 Edwards, J. I.

ALTON

Mississippi Lime Co.
 Crum, E. H.
 No Data Supplied
 Kehr, Edwin A.

AURORA

Stephens Adamson Mfg. Co.
 Parkin, Donald W.
 *Stevens, Arthur J.
 Thor Power Tool Co.
 Johns, B. H.
 No Data Supplied
 Evans, Charles E.

BARRINGTON

Wright and Co.
 Willett, James R.

BELLWOOD

Sun Electric Corp.
 Rennhack, Gilbert A.

BENTON

Old Ben Coal Corp.
 MacDonald, J. W.
 No Data Supplied
 Jankousky, Chas. K.

CAIRO

No Data Supplied
 Sullivan, Dan A., Jr.

CANTON

United Electric Coal Co's
 *Schickedanz, L. H.

CARBONDALE

Southern Illinois Univ.
 *Amos, Dewey H.

CAVE-IN-ROCK

Minerva Oil Co.
 Rule, William T.

CENTRALIA

No Data Supplied
 Carl, James D.

CHICAGO

Airdox Cardox Products Co.
 Hennessy, William R.
 Manley, Paul C.
 Sims, C. Bimford
 Allen & Garcia Co.
 Cain, Hollis B.
 Dowlin, Donald H.
 Garcia, John A., Jr.
 *Von Meding, William
 Allis Chalmers Mfg. Co.
 Schaub, Henry W.
 Snarr, J. W.
 American Brake Shoe Co.
 Ward, Gilfray
 A. E. Anderson Construct. Co.
 Anderson, A. E.
 Armour & Co.
 *Corley, Hoyt M.
 Armour Chemical Div.
 *Baaron, Robert E.
 *Parks, John R.
 Bell & Zoller Coal Co.
 Rasmussen, R. C.
 B. I. F. Industries
 Gregg, T. H.
 Board of Education
 Eberle, Herman R.
 A. J. Boynton & Co.
 Eberlein, John B.
 Calumet & Hecla Inc.
 Bassett, H. Y.
 Lovell, Endicott R.
 Peterman, A. E.

Illinois-Illinois

Chic. Wilmington & Franklin Coal Co.
 *Harrington, George B.
 Climax Molybdenum Co.
 Goth, John W.
 Coal Engineering Co.
 *Edwards, Philip J.
 Commercial Test & Engr.
 *Langtry, W. D.
 Dorr-Oliver Inc.
 Johnson, Roy A.
 Fansteel Metallurgical Corp.
 Highriter, Harry W.
 Gardner Denver Co.
 Boynton, D. R.
 Gen. Amer. Trans. Corp.
 *Gutzeit, Gregoire
 *Parker, Norman H.
 Seery, Frank E.
 Goodman Mfg. Co.
 *Cook, Forrest M.
 Cosgrove, John C., Jr.
 Cunningham, Morris F.
 *Ferguson, William T.
 Goodman, William E.
 Goudge, Robert F.
 Hoskins, Earl R.
 *Long, Norman W.
 Newton, John S.
 Whitton, Ronald W.
 Great Lakes Carbon Corp.
 *Triska, Alfred A.
 Griffin Pipe Div.
 Marold, Frank
 Hardinge Co. Inc.
 Doelp, E. B.
 Hooper-Green Co.
 *Green, J. G.
 Industrial Enterprises Inc.
 Dunyon, A. F.
 Inland Steel Co.
 Block, Philip D., Jr.
 Graff, Howard M.
 Hunter, L. B.
 Jacobs, Carl B.
 Johnson, Hjalmar W.
 International Harvester Co.
 Bercher, H. O.
 *Lindgren, R. A.
 Solecki, Edward A.
 Jet Oil Co.
 Green, T. Howard
 Link-Belt Co.
 Davidson, D. E.
 Geyler, Warren C.
 Holmes, Albert W.
 Linton, Thomas
 Millard, L. O.
 Mitchell, Chas. R.
 Sayers, Robt. P.
 Ralph J. Lofquist Co.
 *Lofquist, Ralph J.
 Maclean-Hunter Publ. Co.
 Lindsay, George C.
 Marquette Cement Mfg. Co.
 Tripp, Fred B.
 Material Service Corp.
 Crown, Irving
 John F. Meissner Engrs. Inc.
 *Meissner, John F.
 *Larson, Bennett C.
 Midcontinent Coal and Coke Co.
 *Wood, Leighton S.
 The Middlekauff Corp.
 Middlekauff, R. J.
 Miller & Co.
 Nicholas, J. R.
 Morton Salt Co.
 Pyle, George R.
 Naylor Pipe Co.
 Allen, J. M.
 Old Ben Coal Corp.
 Campbell, William C.
 PAR Associates
 *Robbins, F. Peter
 Pit and Quarry Publications
 Trautner, Walter E.
 Plymouth Coal Co.
 MacKay, Robert
 Portland Cement Asso.
 *Brown, Levi S.
 Porter, Edward S.
 Process Development Co.
 Ritsch, H. P.
 Roberts & Schaefer Co.
 *Dawson, Raymond E.
 McCulloch, Wm. C.
 *Reeves, Phil C.
 Wagner, Raymond
 Wender, James D., Jr.
 Zaborowski, Robert
 Rock Prod. & Concrete Products
 Lenhart, Walter B.
 Sahara Coal Co.
 Herder, Howard A.
 Woods, Henry C.
 Standard Silica Corp.
 Allport, Hamilton
 Traylor Engineering & Mfg. Co.
 *Weddle, J. L.
 M. H. Treadwell Co. Inc.
 Sayre, Paul L.

Tretol Inc.
 *Patterson, Raymond
 Truax-Tracer Coal Co.
 Dress, Laning
 *Hicks, Harold N.
 Livingston, H. C.
 Sutherland, R. L.
 Turner Construction Co.
 Hernandez, Clinton N.
 United Electric Coal Co.
 Gaber, Andrew J.
 Huey, John J.
 Kolbe, Frank F.
 Latimer, Thomas H.
 Utterback, G. H.
 U.S. Gypsum Co.
 Appleyard, Frank C.
 Eckrote, K. R.
 *Runvik, Richard C.
 U.S. Rubber Co.
 Knobloch, Richard F.
 U.S. Steel Corp.
 Greenberg, Asher
 Univ. of Chicago
 Heydegger, H. Roland
 Univ. of Illinois
 Karpinski, R. W.
 Wedron Silica Co.
 Gawthrop, Alfred
 Paul Weir Co. Inc.
 *Ball, Clayton G.
 *Chapman, George H.
 *Gammeter, Erwin
 *Good, John E.
 Hall, Robert B.
 *Kachik, David J.
 *Stoiser, Lee R.
 *Weir, John P.
 *Weir, Paul
 *Zimmerman, Raymond E.
 Western Electric Co.
 Scott, J. Walter
 Western Knapp Engrg. Co.
 *Chen, Wen-Lan
 Western Precipitation Corp.
 Scherr, Eugene F.
 Wisconsin Steel Works
 Wheatley, Roy P.
 Wyandotte Chem. Corp.
 Edgerton, Bradford P.
 M. A. Young & Co.
 *Fitterman, Morlan E.
 Zonolite Co.
 *Kelly, Joseph A.
 No Data Supplied
 Bell, John H.
 Briggs, H. Kenneth
 *Bryant, A. D.
 *Castle, James E.
 *Read, Davis
 Destr, Donald M. J.
 Fletcher, J. H.
 Gerdtz, Robley F.
 Gericke, W. O.
 Hayden, C. T.
 Kenney, J. R.
 Kremm, G. F.
 Rockwood, Nathan C.
 Slomer, Joseph O.
 *Treadwell, Harry A.
 Vines, H. J.
 *Wagner, H. A.
 COAL CITY
 No Data Supplied
 McKee, M. A.
 COLLINSVILLE
 No Data Supplied
 Bollinger, G. A.
 Brown, Oren P.
 DIXON
 Ill. State Highway Dept.
 Kustka, Joseph R.
 DU QUOIN
 Airmite-Midwest Inc.
 Albion, Dean E.
 EAST ALTON
 Olin Mathieson Chem. Corp.
 Hamilton, Norl A.
 EAST PEORIA
 No Data Supplied
 Hansen, Robert C.
 EAST ST. LOUIS
 Alcoa
 Basler, Wayne G.
 Bell, Gordon M.
 American Zinc Co. of Ill.
 *Meek, Fred J.
 C. E. Williams & Co.
 Stewart, T. J.
 No Data Supplied
 Gregson, V. G., Jr.
 Reed, Merle J.

ELDORADO
 Minerva Oil Co.
 *Daly, J. J.
 Montgomery, Gill
 Speed, Durward C.
 ELGIN
 Ill. Div. Hgways.
 Manderfield, Charles Y.
 State Highway Dept.
 *Safak, Husamettin
 ELIZABETHTOWN
 Minerva Oil Co.
 Anderson, Oliver E.
 Cunningham, William D.
 *Saxby, Donald B.
 No Data Supplied
 Haman, Miles
 ELMHURST
 No Data Supplied
 Anderson, Charles S.
 Biddulph, Robert L.
 ELSAH
 Principia College
 *Gore, Dorothy J.
 EVANSTON
 Northwestern Univ.
 *Dapples, Edward C., Jr.
 No Data Supplied
 Dickson, Robert B.
 FARMERSVILLE
 Freeman Coal Mining Corp.
 Fox, James M.
 GALENA
 The Eagle-Picher Co.
 Arndt, William E.
 Haffner, Robert L.
 Haman, Harold H.
 *Thaler, Julio H.
 Willowa Engrg. Co.
 *Miles, Edwin H.
 GALESBURG
 Bixby-Zimmer Engrg. Co.
 Rose, Colin G.
 No Data Supplied
 Bixby, K. R.
 GLENCOE
 No Data Supplied
 Young, Wm. F.
 GLEN ELLYN
 No Data Supplied
 Lehman, Lewis H.
 GLENVIEW
 No Data Supplied
 Nordberg, Bror
 GRANITE CITY
 Granite City Steel Co.
 *Deptula, Walter J., Jr.
 GREENVILLE
 Coates Steel Prod. Co.
 Lowe, Robert C.
 HANOVER
 No Data Supplied
 Kuehneman, Robt. J.
 HARRISBURG
 Sahara Coal Co.
 Bottomley, J. A.
 HIGHLAND PARK
 No Data Supplied
 Baker, Thomas C., Jr.
 Miller, R. G., Jr.
 HILLSBORO
 Amer. Zinc Co. of Hillsboro
 Wampler, Harold Ray
 HINSDALE
 No Data Supplied
 Joschim, Ernest G.
 Mann, Donald M.
 Schoenberger, Pope

KANKAKEE
 General Mills Inc.
 Terry, David E.
 LEMONT
 No Data Supplied
 Ellis, Joseph M.
 LOMBARD
 No Data Supplied
 Komarek, Karl R.
 MARION
 No Data Supplied
 Adams, R. L.
 MC HENRY
 Nelson L. Davis Co.
 *Davis, N. L.
 MELROSE PARK
 Amer. Brake Shoe
 Nickel, Henry W., Jr.
 Hewitt-Robins Inc.
 *Larsen, Edw. P.
 Phillips, Chelsea R.
 MOLINE
 Moline Consumers Co.
 Ellis, James Oscar
 No Data Supplied
 Stoewer, William H.
 MT. CARMEL
 No Data Supplied
 Sharp, C. Sheldon
 MURPHYSBORO
 No Data Supplied
 Hanson, S. A.
 WASHVILLE
 National Mine Service Co.
 Conway, Clifford C.
 OAK PARK
 Fenwal Inc.
 Ruffner, John M.
 OTTAWA
 Ottawa Silica Co.
 *Gerding, Paul A.
 Gyger, W. B.
 McClevey, R. A., Jr.
 No Data Supplied
 Burke, Barry L.
 *Matkovic, Dr. Mijo
 PALATINE
 The Eimco Corp.
 Dahlstrom, D. A.
 Vrablik, E. R.
 No Data Supplied
 Cornell, Conrad F.
 Silverblatt, C. E.
 Williams, Nolan H.
 PARIS
 Ill. Cereal Mills Inc.
 DuMond, John L.
 No Data Supplied
 Sutherland, R. G.
 PARK RIDGE
 No Data Supplied
 *Glos, Edmond A., II
 PEORIA
 Caterpillar Tractor Co.
 Haley, Wilbur A.
 Radomsky, John
 Ill. Division of Highways
 Squires, Robert L.
 No Data Supplied
 Clay, Richard T.
 Leong, Judson
 PERCY
 Southwestern Ill. Coal Corp.
 *Bridges, Raymond H.
 PLAINFIELD
 No Data Supplied
 Hogan, Daniel J. Jr.

QUINCY
 Gardner-Denver Co.
 Fishback, Niel M.
 Ganz, Robt. H.
 Gardner, John W.
 Kuykendall, J. E.
 *Riegel, James E.
 Winters, Arthur B., Jr.
 RIVERDALE
 Acme Steel Co.
 Gillies, F. M.
 RIVERSIDE
 No Data Supplied
 Listak, John
 ROBINSON
 No Data Supplied
 Zwernman, Carl H.
 ROCK ISLAND
 Bituminous Casualty Corp.
 *Herbert, Charles F.
 ROSCOE
 No Data Supplied
 Sager, Ronald L., Jr.
 ROSICLARE
 Alcoa
 *Bousman, Samuel G.
 Harrison, William H., Jr.
 Moritz, John A.
 Shaw, Chester W.
 *Skeels, Walter S.
 Wrobel, Fred C.
 Ozark Mahoning Co.
 Baile, Harold E.
 Brecke, Ervin A.
 Rosiclare Lead & Fluorspar Mine Co.
 Blechisen, Jacob
 So. Ill. Min. Co.
 Shoemaker, Jay C.
 No Data Supplied
 Fulghum, Weldon F.
 SCALES MOUND
 No Data Supplied
 Colin, Stanley B.
 SKOKIE
 American Colloid Co.
 Bechtner, Paul
 Johnson, J. D.
 Intnatl. Minerals & Chem. Corp.
 Arend, Carl A., Jr.
 Blazovic, Phil, Jr.
 Clawson, Floyd J.
 Dunbeck, Norman J.
 *Hunter, Dr. Frank R.
 Kruger, Frederick C.
 LeBaron, I. Milton
 Mataich, Peter F.
 *Reuss, John L.
 Roe, Lawrence A.
 Ware, Thomas M.
 White, Nelson C.
 Portland Cement Asso.
 Bates, A. Allan
 Clausen, Carl F.
 No Data Supplied
 Buettner, Melvin A.
 Toney, J. Richard
 Tucker, Robert G.
 Ware, Louis
 SPRINGFIELD
 No Data Supplied
 Jess, John Agee
 Spanski, R. F.
 Van Maele, Albert L.
 TAYLORVILLE
 Peabody Coal Co.
 *Cookkey, Joel N., Jr.
 URBANA
 Ill. State Geol. Survey
 *Bradbury, James C.
 *Cady, Gilbert H.
 Frye, John C.
 Harrison, John A.
 Heflin, Roy J.
 Jackman, Harold W.
 Lamar, John E.
 *Machin, James S.
 *Ostrom, Meredith Eggers
 Risser, Hubert E.
 Simon, Jack Aaron

Illinois-Kentucky

Univ. of Illinois
 *Chedsey, Wm. R.
 *Eadie, George R.
 Moore, John E.
 *Voskuil, Walter H.
 White, George W.
 *Wright, Fred D.
 *Wuerker, Rudolph G.

WEST CHICAGO

Lindsay Chem. Div.
 Kremers, Howard E.

WHEATON

No Data Supplied
 Burrows, John P.
 Gilbert, R. W.

WILMETTE

U.S. Army Snow, Ice,
 Permafrost Res. Estab.
 *Abel, John F., Jr.
 McAnerney, John M.
 *Sulzbach, John F.

WINETKA

No Data Supplied
 Irwin, David D.

INDIANA

BEDFORD

Ingalls Stone Co.
 Ingalls, Robert

BLOOMINGTON

Indiana Univ.
 Deiss, Charles F.
 *Lowell, Wayne Russell
 Mead, Judson
 Patton, John Barratt
 Sparks Tarzian Inc.
 *Winter, Wilbur B.
 No Data Supplied
 Legge, Theo. Worley

BRUCEVILLE

Enoco Collieries Inc.
 Conrad, Heber A.

BUFFINGTON

Universal Atlas Cement
 Rader, Herbert L.

EAST CHICAGO

Inland Steel Co.
 Holowaty, M. O.
 *Isenberg, Nathan
 *Mareta, Joseph T.
 Matthews, Wm. H.
 Moliken, William R.
 U.S. Gypsum Co.
 Sieh, Clayton

ELBERFELD

Ingle Coal Corp.
 Ingle, David
 Ingle, William Davidson, Jr.

EVANSVILLE

No Data Supplied
 Yeager, George G.

FORT WAYNE

The Deister Concentrator Co.
 Griffin, Donald N.
 Mancini, Peter V.
 Tiernon, C. H.

GARY

J. J. Grady Co. Inc.
 Grady, John J.
 U.S. Steel Corp.
 Walsh, John M.
 USS Universal Atlas Cement
 Div.
 *Ludwig, Norman C.
 No Data Supplied
 Cavanaugh, John P.

HAMMOND

Designer's Metal Corp.
 Tindall, Jesse E.

INDIANA HARBOR

Inland Steel Co.
 Sheets, Cleo B.

INDIANAPOLIS

Ayrshire Collieries
 Hannum, Arnold M.
 *Hightower, Thomas R.
 Merlie, James J.
 Swallow, Richard H.
 Fuel Res. Lab. Inc.
 *Mulcahy, Bernard Patrick
 P. R. Mallory & Co.
 Moore, Charles H.
 Sigurdson, Harold
 Morgan Coal Co.
 Spears, Miller E.
 Pickands Mather & Co.
 Tuttle, Max A.
 Stonefort Corp.
 Dukes, William W.
 *King, Addison H., II
 Sherwood, S. F.
 Clyde E. Williams & Assoc.
 Hilley, C. M.
 No Data Supplied
 Hitchcock, Charles K.

LEBANON

No Data Supplied
 Hoadley, John A.

MEDARYVILLE

No Data Supplied
 Rosenberg, Louis

MICHIGAN CITY

Joy Mfg. Co.
 *Whinnen, W. J.
 Rock Island Railroad
 *Sibley, Milton W.
 No Data Supplied
 Connelly, Thos. J.

MUNCIE

Indiana Steel & Wire Co. Inc.
 Holmes, Alvin W.

MUNSTER

No Data Supplied
 Ziehl, Otho A.

NEWBURGH

Alum. Co. of Amer.
 Greves, John H.

NOTRE DAME

Univ. of Notre Dame
 *Peretti, E. A.

OAKLAND CITY

The Enos Coal Min. Co.
 Mullins, R. A.

RENSSELAER

St. Joseph College
 *Nieset, Carl F.

RICHMOND

Bucyrus Erie Co.
 Grayer, George D.
 Madison, Dick L.
 Piper, William G.

SHOALS

U.S. Gypsum Co.
 *Wynn, Leonard E.
 No Data Supplied
 Stevens, Paul M.

SOUTH BEND

Curtiss-Wright Corp.
 Marsh, Wm. J.

TERRE HAUTE

Reich Mfg. Co. Inc.
 *McCabe, G. P.
 Reich, Wendell L.
 Snow Hill Coal Co.
 Gossard, Amzi G.
 Templeton-Matthews Corp.
 *Matthews, Max A.
 The Maumee Collieries Co.
 *Lee, Hugh B.
 *Stewart, Lafe
 No Data Supplied
 Hodgson, C. H.
 Philippi, L. B.
 Tobey, J. E., Jr.

VINCENNES

Enoco Collieries Inc.
 Stachura, John A.
 No Data Supplied
 Hansen, M. V.

WABASH

Amer. Rock Wool Corp.
 House, Robert M.

WARSAW

Amer. Brattice Cloth
 Marshall, Lawrence K.

IOWA

AMES

Iowa State College
 Gwynne, C. S.
 *Lemish, Dr. John

IOWA CITY

Univ. of Iowa
 *Hewlett, Richard F.

KEOKUK

No Data Supplied
 Dresser, C. G.

WILLIAMS

No Data Supplied
 Mark, 2nd Lt. David L.

KANSAS

BAXTER SPRINGS

Amer. Smelt. & Ref. Co.
 Ball, Ward C.
 Nat'l. Lead Co.
 Schaefer, Geo. R.
 Weidman Indust. Inc.
 *Weidman, Thomas H.
 No Data Supplied
 *Clarke, Sim S.
 Kline, Euane M.
 Stipe, J. C.
 Stroup, R. J.
 Stroup, Robert K.
 Weidman, H. G., Jr.
 Weidman, Hubert G.

CHANUTE

No Data Supplied
 Hurt, E. F.

COFFEYVILLE

Ozark Smelt. & Min. Co.
 *Wigton, George H.
 Wyman, George F.

FT. RILEY

U.S. Army
 Copeland, Lt. James B.
 Rutledge, Gerald E.

HUMBOLT

No Data Supplied
 Fegely, H. V.

HUTCHINSON

The Carey Salt Co.
 *Stone, Ronald B.

KANOPOLIS

Independent Salt Co.
 *Hunt, D. M.

LAWRENCE

Hercules Powder Co.
 Leek, Wm. J., Jr.
 Kansas Geol. Survey
 King, Ralph H.
 Kulstad, Robert
 *Runnels, Russell T.
 Univ. of Kansas
 *Gillerman, Elliot
 *Rankin, Frederick V.
 Smithmeyer, F. C.
 No Data Supplied
 Nixon, Earl K.

LIBERAL

The Texas Co.
 Wolle, Peter C.

PITTSBURGH

McNally Pittsburg Mfg. Corp.
 McNally, Thomas
 *Woodhead, Robert C.
 Pittsburg & Midway Coal
 Citron, Elmer H.
 Phelps, Edwin R.

No Data Supplied
 Compton, Harold W.
 Spencer, W. C.

PRAIRIE VILLAGE

No Data Supplied
 Prince, J., Jr.

ST. FRANCIS

No Data Supplied
 Winston, James M.

SHAWNEE

No Data Supplied
 Orelup, L. C.

TOPEKA

No Data Supplied
 Huebner, G. Robert

WICHITA

Boeing Airplane Co.
 *McIntosh, Roy T.
 U.S. Treasury Dept.
 Ruhe, Karl
 Univ. of Wichita
 *Berg, J. Robert
 No Data Supplied
 *LeCount, Evans D.
 *Reigart, John Routt

KENTUCKY

ASHLAND

Armco Steel Corp
 Todd, George H.

BARBOURVILLE

U. S. Bureau of Mines
 Parry, George W.

BENHAM

Intl. Harvester Co.
 Irwin, C. H.
 Newman, E. K.
 No Data Supplied
 Cole, Perry W.

BEREA

Berea College
 Smith, Riley S., Jr.

BIGGS

Feds Creek Coal Co. Inc.
 Venable, R. V.

CORBIN

U. S. Steel Corp.
 Hamlet, A. E.
 Witt, Robert, Jr.

DANVILLE

No Data Supplied
 Tuttle, Arthur L.

DAVID

Princess Elkhorn Coal Co.
 Salisbury, Fred H.

DRAKESBORO

F & M Coal Mining Co.
 Sorrell, Sherwood W.

DRIFT

Turner Elkhorn Min. Co.
 Reed, B. F.

DUNLAP

No Data Supplied
 Robertson, Franklin

EVANSTON

Island Creek Coal Co.
 Jones, Kenzie

FT. CAMPBELL

U. S. Army
 Beckman, Robert T.

FT. KNOX

No Data Supplied
 Moulds, Donald G.

HARLAN

Silas Campbell Const. Co. Inc.
 Hensley, James D.

HAZARD

Scuddy Coal Co. Inc.
 Eckert, A. R.
 No Data Supplied
 Brabest, Eugene
 *Spalding, Henry A.

JENKINS

Beth Mines Corp.
 Dittick, A. C.
 Halbert, Charles D.
 Mercer, H. C.
 Prunty, M. E.
 Storey, Richard W.
 Zegeer, David A.
 No Data Supplied
 Harria, Olie E., Jr.
 Kegan, Seth H., Jr.
 Sewell, Henry S.
 Wilson, James C.

LANCASTER

York Mining Co.
 York, Roy J., Jr.

LATONIA

L & N R. R. Co.
 Hodge, Rex

LEXINGTON

James M. Daniel & Assoc.
 *Daniel, James M.
 Univ. of Kentucky
 *Roll, Wm. H.
 *Spokes, Ernest M.
 No Data Supplied
 *Emrath, Phillip C.
 Willmott, Curtis L.

LOUISVILLE

No Data Supplied
 Carter, Carroll S.

LYNCH

U. S. Steel Corp.
 Blankenship, D. K.
 Burg, Stoddard S.
 Egan, Howard N.
 Gibson, William E.
 Johnson, Kenneth A.
 Keefer, W. W.
 Radomsky, George
 Schroder, John L., Jr.
 Scrugham, Hal M.
 Stewart, James Robert
 No Data Supplied
 Bitner, A. Wayne
 Felton, James O., Jr.
 Merritt, Jack A.
 Storey, Clyde H.
 Yarbrough, Norman

MADISONVILLE

Colonial Coal Min. Co.
 Miner, J. A.
 Paul M. Jones & Assoc.
 *Jones, Jaul M.
 Nashville Coal Inc.
 *Haley, Ted D.
 West Kentucky Coal Co. Inc.
 Knight, Herman E.
 Patterson, Moss
 No Data Supplied
 *Donan, John G.

MARION

Kentucky Fluorspar Co.
 Frazer, R. N.
 Penn. Salt Chemicals Corp.
 *Tibbs, John S.
 West, La Mont
 No Data Supplied
 Clement, Ben E.

FAINTSVILLE

Smith-East Coal Co.
 LaViers, Harry

PIKEVILLE

Big Sandy Elkhorn Co.
 Mosgrove, J. H.
 No Data Supplied
 *Batten, O. S.
 Penny, D. A.

PRESTONBURG

Beaver Creek Cons. Coal
 Corbin, Carl H.
 Prestonburg Engng. Co.
 *Reed, Charles Alan

STONE

Eastern Coal Corp.
 Price, Vance

Kentucky-Michigan

Ford Motor Co.
*Apple, Foster L.

WAYLAND

Evans Elkhorn Coal Co. Inc.
Evans, George E., Jr.
Howard, N. D.

WHEELWRIGHT

Inland Steel Co.
Bradbury, Arthur
Brody, Albert J.
Gibson, R. W., Jr.
Grimm, Bobby M.
Jones, Donald E.
Pace, E. Minor
Roberts, E. H., Jr.
Zimmerman, H. O.
No Data Supplied
Banks, Ralph
Newman, S. M., Jr.
Peraio, Joseph J.
Shockley, R. R.

WILLIAMSBURG

Gatliff Coal Co.
Gatliff, James B., Jr.

LOUISIANA

AVERY ISLAND

No Data Supplied
Terrell, E. P., Jr.

BATON ROUGE

Kaiser Alum. & Chem. Co.
Jones, Robert L.
Phillips, Weller A.
Sparkman, James E.
Louisiana State Univ.
*Cordiner, James B., Jr.
*Sandberg, Adolph E.
No Data Supplied
Howard, C. Edward

BURNSIDE

Ormet Corp.
Felder, Joseph G.

GRAMERCY

Kaiser Alum. & Chem. Corp.
Blest, Raymon C.
Dalton, Benjamin S.

LAFAYETTE

Sohio Petroleum Co.
Souders, P. Barkley
Southwestern Inst.
*Paine, William R.

LAKE CHARLES

No Data Supplied
Woodman, Frank W.

LUTCHER

No Data Supplied
Johnson, Walter B.

MARRERO

Garrett Oil Tools
Conner, Jack T.

NEW IBERIA

Phipps Drill Bit Co.
*Phipps, Orville
No Data Supplied
Johnson, F.
Jordan, F. L.

NEW ORLEANS

Freeport Sulphur Co.
Axelrad, B. A.
Feierabend, Raymond H.
Flint, Delos E.
Lee, Clarence O.
La Lue Mines, Ltd.
Keyes, Harmon E.
Nat'l. Lead Co.
Middleton, David M.
No Data Supplied
Deutsch, C.
Nixon, Edward C.

PORT NICKEL

Freeport Nickel Co.
Beyer, Arthur J.

PORT SULPHUR

Freeport Sulphur Co.
Gustafson, A. A.
Monroe, John E.

No Data Supplied
Bailey, John H., Jr.
Sears, G. C.

RUSTON

La. Polytechnic Inst.
*Allen, Rhessa M., Jr.

SHREVEPORT

William M. Barret, Inc.
Barret, William M.
No Data Supplied
Brown, Frank E.
*Forgoston, James M.
*Stevens, George R.

VINTON

No Data Supplied
Blanccke, C. D., Jr.

WEEKS

Morton Salt Co.
West, Wayne

MAINE

AUBURN

No Data Supplied
Cummings, John S.

BANGOR

No Data Supplied
Bridge, Burrill A.

FORT WILLIAMS

No Data Supplied
Krumlauf, Lt. Harry E., Jr.
*Krumlauf, Harry E., Jr.

HALLOWELL

No Data Supplied
*Rand, John R.

OGUNQUIT

No Data Supplied
Perkins, Grover S., Jr.

OLD TOWN

James W. Sewall Co.
*Wing, Lawrence A.

MARYLAND

BALTIMORE

Baltimore & Ohio R. R. Co.
*Kerr, Eugene J.
Shrode, R. S.
W. R. Grace & Co.
Harris, John M.
Ellicott Mach. Corp.
*von Bolhar, Edgar
Johns Hopkins Univ.
Singewald, Joseph T., Jr.
Kennecott Refining Corp.
Pickering, Ivor G.
Martin Co.
*Dix, George P., Jr.
Enoch Pratt Free Library
Hart, Eugene

BALTIMORE

No Data Supplied
Bird, Thomas H.
Keeney, James F.
Spooner, William H.
Williamson, C. J.

BELTSVILLE

U. S. Geol. Survey
Singewald, Quentin D.

BETHESDA

No Data Supplied
Denton, T. C.
Kilgaard, T. H.
*Tyler, Paul M.

CHEVERLY

No Data Supplied
Franklin, R. K.

CHEVY CHASE

*No Data Supplied
Car, Maurice
Corgan, Joseph A.
O'Neill, Leo J.
Reeder, Robert D.
Sloman, Harold J.

COLLEGE PARK

U. S. Bureau of Mines
Eilertsen, Nils A.
Fraas, Foster
Lewis, Allen
Shelton, John E.
Stock, John A.
Swanson, Vernon F.
Univ. of Maryland
*Schroeder, W. C.

DAMASCUS

No Data Supplied
Gardner, C. I.

EASTON

No Data Supplied
Riddell, Guy C.

EDGEWATER

No Data Supplied
Griggs, C. C.

FROSTBURG

No Data Supplied
Hartig, Philip, Jr.

GERMANTOWN

Atomic Energy Comm.
Kennedy, Richard H.

HAGERSTON

No Data Supplied
Carlevato, Harold G.

HYATTSVILLE

No Data Supplied
Anderson, Sumner M.
Pike, Charles S.
*Ralston, Oliver C.

KENSINGTON

No Data Supplied
Richards, Owen

MUIRKIRK

No Data Supplied
Otis, LeRoy M.

ROCKVILLE

No Data Supplied
Moyer, Forrest T.

SILVER SPRING

Johns Hopkins Univ.
Heuring, Francis T.
U. S. Geol. Survey
Robertson, Eugene C.
No Data Supplied
Barwick, Arthur R.
Kennedy, Donald O.
May, Robert F.
*McDonald, Joseph F., Jr.
Obert, Leonard

SUITLAND

U. S. Navy Hydrographic
Office
Scull, David C.

TAKOMA PARK

No Data Supplied
*Perkins, Russel G.

TIMONIUM

No Data Supplied
Breza, H. Michael

UNIVERSITY PARK

No Data Supplied
Pancik, Louis A.

MASSACHUSETTS

AMESBURY

Callahan Mining Corp.
Mahoney, R. F.

AMHERST

Amherst College
Bain, George W.

AUBURNDALE

No Data Supplied
*Paddison, L. F.
*Woods, Basil Kirkland

BELMONT

No Data Supplied
Gilman, George H.

BOSTON

Allis Chalmers Mfg. Co.
*Everts, Robert B.
Beacon Constr. Co. Inc.
*Waltch, Mark J.
Copper Range Co.
Goodwin, David M.
Eastern Gas & Fuel Assoc.
Granger, Graham
Harvard Univ.
Fayerweather, J.
Wilhelm, George L.
Keweenaw Land Assoc. Ltd.
Taylor, Carroll C.
North Amer. Mines, Inc.
Livermore, Robert
Shaw, Quincy Adams
U. S. Smelting, Ref. & Min.
Co.
Duriez, Leo H.
Graves, William H., Jr.
Metcalfe, John B.
No Data Supplied
Brown, Davenport
Coburn, Wm. H.
*Crosby, Irving B.
Gillis, Kenneth
Jackson, Danforth
Mulock, Fred S.
*Talbot, Harold L.

BRIGHTON

No Data Supplied
Shapiro, Samuel

BROOKLINE

No Data Supplied
Ravreby, Fred A.

CAMBRIDGE

Harvard Univ.
Anderson, James A.
*Cloke, Paul L.
*McKinstry, H. E.
*Schoen, Robert
Arthur D. Little, Inc.
Almeida, A. Robert
*Flood, H. W.
*Gibbons, Donald R.
Lane, Bruce M.
*McAllister, Robert W.
Mass. Inst. of Tech.
*Brown, J. H.
*Brownlow, Arthur H.
*deBruyn, P. L.
Foster, F. Leroy
*Gaudin, A. M.
*Hurley, Patrick M.
Mead, Warren J.
*Mular, Andrew L.
*Parker, Roland Dane
No Data Supplied
*Gibson, Russell
*Navias, Robert A.

CANTON

Emerson & Cuming, Inc.
*Leforge, John W.

FARNUMS

No Data Supplied
Voelker, Mervin J.

LEE

Perini Corp.
Rape, Sylvester H.

LENOX

Stokes Properties Inc.
Stokes, William E. D., Jr.

LINCOLN

No Data Supplied
*Smith, C. DeWitt

LYNN

No Data Supplied
Winslow, S. M.

MARBLEHEAD

No Data Supplied
Breyman, J. B., III

MATTAPAN

No Data Supplied
Pechet, M. S.

MEDFORD

No Data Supplied
Layman, F. G.

NEWTON

No Data Supplied
*Laddo, Raymond B.
Lukens, Alan R.

NEWTONVILLE

Jarrell-Ash Co.
*Jarrell, Oscar W.

NORWOOD

No Data Supplied
Gillis, J. J.

QUINCY

Eastern Engrg. Sales Co.
Smith, James LeRoy

READING

No Data Supplied
Owens, Robert L.

SEEKONK

No Data Supplied
Wilson, Carroll L.

SOUTH WALPOLE

Bird Machine Co.
Shepherd, Henry H.

WABAN

No Data Supplied
Moore, Carl F.

WALTHAM

U. S. Air Force
Brewer, Howland S.
U. S. Army
Gurley, Robert C.

WELLESLEY HILLS

No Data Supplied
*Douglas, C. B. E.

WEST CHELMSFORD

H. E. Fletcher Co.
Fletcher, R. Andrew, Jr.
Mould, Channing B.
No Data Supplied
Fletcher, R. A.

WESTFIELD

Micro Abrasives Corp.
*Nesin, Asher

WESTOVER

No Data Supplied
Gallemore, W. A.

WINCHESTER

Nat'l. Lead Co. Inc.
McArthur, C. K.
No Data Supplied
Newton, Roger H.

WORCESTER

Norton Co.
Clarke, Robert G.

YARMOUTH

No Data Supplied
Emerson, L. W.

MICHIGAN

ADRIAN

No Data Supplied
Eskilsen, Emil E.

ALABASTER

U. S. Gypsum Co.
Lucke, Edward W.
*Van Ornum, M. H.

ANN ARBOR

Univ. of Mich.
Boyer, William H.
*Heinrich, E. Wm.
Kraus, Edward H.
*Landes, Kenneth K.
*Williams, G. Brymer
*York, J. Louis
No Data Supplied
*Bush, John M.
Johnson, Alvin C.
Perhac, Ralph M.
Turneure, F. S.

BENTON HARBOR

Clark Equipment
*Barnes, Parry

BESSEMER

No Data Supplied
*Coster, W. A.

CALUMET

Calumet & Hecla, Inc.
Benedict, C. Harry
Kromer, A. S.
*Kuchta, Ernest M.
Landstrom, Arnold B.
Pierce, Robert L.
Follock, James P.
Foull, R. K.
Schilling, Alvin W.
Sharps, Thomas I.
*Spencer, R. Robbins
*Vitton, John J.
No Data Supplied
*Broderick, Thomas M.
Campbell, Colin A.
Miller, Emory W.
*Wohlrah, Aloys H.

CASPIAN

Pickands Mather & Co.
Bailey, Carlton D.
*Martini, Arthur A.

CENTER LINE

U. S. Defense Dept.
*Keenan, Emil B.

CLOVERDALE

No Data Supplied
Smith, Richard A.

CRYSTAL FALLS

Inland Steel Co.
Ahl, W. J.
No Data Supplied
Hagglund, Walter E.
Nicolson, John A.
*Pardee, Franklin G.
Warren, E.

DEARBORN

Ford Motor Co.
Bodor, Robert L.
No Data Supplied
Hosmer, Henry L.
Wade, Robert W.
Gabel, Gerald R.

DETROIT

Drummond Dolomite Inc.

DETROIT

Detroit Public Library
*Uveling, R. A.
Detroit Testing Lab.
Putnam, Wm. P.
Fargo Mach. & Tool Co.
*Haworth, Roy D.
General Elect. Co.
*Bower, Arnold B., Jr.
Hinchman Corp.
Michelson, John A.
Int'l. Salt Co.
*Jacoby, Charles H.
*Read, Leo E.
John F. Meissner Engrs., Inc.
*Ashurst, O. P.
U. S. Army
Greiner, Pete
U. S. Gypsum Co.
Kebel, Harlan L.
U. S. Steel Co.
Beukema, Christian F.
Ferguson, Herman W.
Wheel Trueting Tool Co.
Adamson, Patrick
Pickard, A. Frank
No Data Supplied
Bleimeister, Wm. C.
Foreman, Charles G.
Goetzcke, John W.
Heron, S. D.
Hillebrand, James R.

DUNDEE

Dundee Cement Co.
Martin, Roblee B.

EAST LANSING

Michigan State Univ.
*Wayman, Cooper H.
*Zinn, Justin
No Data Supplied
Renner, Karl H.
Vehrs, Robert A.

FERNDALE

Allegheny Ludlum Steel Co.
Graham, James A.

GALESBURG

No Data Supplied
Becker, Dallas

GRAND RAPIDS

AMI, Inc.
Haddock, John W.
Bestwall Gypsum Co.
*Allen, Thomas J.
Grand Rapids Plaster Co.
Johnston, Charles E.
No Data Supplied
Keeler, William S.

GREENVILLE

No Data Supplied
Dibble, Robert D.

GROSSE POINTE

No Data Supplied
Margenau, Roy E.

HANCOCK

No Data Supplied
Ellsworth, P. C.
Reeder, J. Harry
Schultz, Clifford W.
Webber, Kenneth P.

HOUGHTON

Isle Royale Copper Co.
Noetzel, Benj. D.
Mich. College of Mining
& Tech.
*Adler, Lawrence
*Bacon, Lloyd O.
*Been, Walfrid
Fisher, James
Harry, Charles M.
*Hockings, William A.
*Keck, Walter E.
*Kennedy, Allen D.
*Kerekes, Frank
*Lentz, Thomas H.
*Neilson, James M.
*Snelgrove, A. K.
*Spiroff, Kiril
*Tolonen, Frank J.
*Van Pelt, J. Robert, Jr.
No Data Supplied
Beard, Dick
MacDonald, Don J.
Manderfield, N. H.
Parker, Jack
*Riddell, J. Murray
Schreier, Thos. F.
Schubert, Geo. P.
Volin, Melden E.

HOUGHTON LAKE

No Data Supplied
Ruby, Robert J.

IRON MOUNTAIN

Ford Motor Co.
Kral, Victor E.
M. A. Hanna Co.
Geist, Elton W.
Lee, Floyd H.
Lake Shore, Inc.
Greenly, John R.
Reeve, B. W.
W. B. Thompson Co.
Shaughency, Harvey C.
No Data Supplied
Berg, W. B.
Johnson, Emmett G.
Thompson, W. B.
Tretthewey, Ben C.

IRON RIVER

M. A. Hanna Co.
Clemens, James W.
Hecker, Thomas C.
Koehler, George A.
McAvillife, John D.
Peterson, Richard W.
Remarcke, George
Walker, A. E.
Zimmer, Paul W.
Inland Steel Co.
*Edwards, Robert W.
Ohlson, John M.
*Tweed, Thomas M.
Mineral Mining Co.
Brown, Fayette E.
Odgers Drilling Inc.
Nelson, Marlowe A.
Odgers, Ira Douglas
No Data Supplied
*Dewald, Walter E.
Kuehlthau, Kurt R.
Neil, Harris A.

IRONWOOD

Mauthe Mining Co.
Sharer, John L.
Pickands Mather & Co.
*Johnson, A. L.
*MacDonald, Kenneth A.
Peterson, Roy I.
Walker, Neal E.
Wangaard, John C.
No Data Supplied
Cigallio, A. J.
Knoll, Waldemar A.
Werther, F. R.

ISHPEMING

Cleveland-Cliffs Iron Co.
Anderson, Gerald I.
Berkahn, Robert W.
Boyum, Burton H.
Campbell, D. Kelly
Crites, Joseph D.
*Eck, Louis J.
Erickson, Lee
*Holt, Gorver J.
Johnson, Edwin B.
LaBelle, R. J. B.
Leach, Hugh J.
Magnuson, Ralph E., Jr.
*Marjama, Onnie
Meyers, James P.
*Nummela, Walter
Sundeen, Stanley W.
Violetta, Donald C.
Westwater, James S.
*Winslow, Kenelm C.
Hercules Powder Co.
Adams, John W.
Inland Steel Co.
Annear, Richard C.
Broderick, Alan T.
Brown, Douglas E.
Lacke, Robert J.
Metzger, Vern E.
Olson, Frederick A.
Pearson, Philip D.
Satterley, Raymond D.
No Data Supplied
Avery, John W.
*Barrett, L. P.
Beinlich, Eric G.
Benson, Wm. A.
Brewer, Carl
*Derby, Edwin L., Jr.
Dureff, George A.
Jackson, George R.
Lindros, Ernest W.
Marin, Martin J.
Nicolson, Clyde W.
Smith, Lawrence E.
Villar, J. W.

KALAMAZOO

Hapman Conveyors, Inc.
Ames, Howard E.

LAKE LINDEN

Calumet & Hecla
Haskell, Robert M.
No Data Supplied
Tregoning, R. A.

LAURIUM

No Data Supplied
Lasio, John

MADISON HEIGHTS

No Data Supplied
Boston, Richard R.

MARQUETTE

Longyear Realty Corp.
Burrall, Frederick P.
Mich. Dept. of Health
McKichan, John D.
No Data Supplied
De Haas, Clyde T.
Clark, James W.

MENOMINEE

No Data Supplied
Norcoras, F. S., Jr.

MIDLAND

Dow Chemical Co.
Cardwell, Paul H.
Naegele, R. E.
Kuchnic, Robert M.
Lokken, John C.
McCarthy, Merrill F.
No Data Supplied
Anderson, Raymond J.
Gould, Wayne D.

MONROE

No Data Supplied
McNairn, John S.

MT. CLEMENS

No Data Supplied
Oliver, Lloyd R.
Williams, Stuart H.

MT. PLEASANT

No Data Supplied
*Brown, William F.

NATIONAL CITY

Nat'l. Gypsum Co.
*McGee, Leamon G.

NEGAUNEE

Burridge-Nyland Equip. Co.
Burridge, Charles E.
Jones & Laughlin Steel Corp.
Ameen, Howard F.
Braund, Robert Wm.
Karkkainen, C. W.
Lemay, Donald B.
North Range Mining Co.
*Archibald, Ralph S.
Archibald, Robert
*Haller, Francis J.
No Data Supplied
Hakala, Oiva W.
Kauppila, T. A.
Korpinen, Hugo H.
Rex, Eric J.

NILES

No Data Supplied
Jarpe, G. E.

PALMER

No Data Supplied
Koski, Roy Andrew

RANDVILLE

M. A. Hanna, Co.
*Smith, Richard R.

ROGERS CITY

U. S. Steel Corp.
Patterson, Lewis J.
Ransom, Wm. R., Jr.

SAINT LOUIS

Mich. Chem. Corp.
*Laczynski, Edward M.
Marvin, Theodore
Whitman, Judson H.

SAULTE STE MARIE

No Data Supplied
Roe, Ray Lyle, Jr.

STAMBAUGH

M. A. Hanna Co.
Duayle, S. E.
No Data Supplied
Anderson, G. L.

TRENTON

No Data Supplied
Castner, Thomas J.

WARREN

Gen. Motors Corp.
Thompson, Dr. R. F.

WHITE CLOUD

No Data Supplied
Maranz, David E.

WHITE PINE

Copper Range Co.
*Ohle, Ernest L.
White Pine Copper Co.
Gamble, Ross E.
*Lesela, Virgil
Lukkarila, Walt Q.
Nicholls, W. F.
Taipale, James M.
No Data Supplied
Raymond, Harold D.

MINNESOTA**AURORA**

Bear Creek Min. Co.
Manuoso, James D.
Union Carbide Corp.
Calaman, Joseph J.

AUSTIN

No Data Supplied
Hillmer, Roy W.

Michigan-Minnesota**RABBITT**

Reserve Min. Co.
Woodie, Merilyn G.

RIWARIE

Pioneer Min. Co.
*Bergstrom, Frank S.

BUHL

No Data Supplied
Baker, John J.

CALUMET

Jones & Laughlin Steel Corp.
*Abercrombie, Russell L.
Gross, Joseph R.
Lemke, Laverne
Livingston, Richard W.
Pettie, R. K.
Snider, James P.

CHISHOLM

Snyder Min. Co.
Barker, Theodore J.
Coen, Kenneth F.
*Ekar, Rudolph A.
Forsmark, M. J.
*Haller, Harry F.
Hoag, Max C.
*Jensen, Frederick T.
Zobitz, Edward
No Data Supplied
Erkkila, Mauri E.
Grant, Charles H.
Wallace, Robert R.

COLD SPRING

No Data Supplied
Alexander, John C.

COLERAINE

Pickands Mather & Co.
Hustad, M. Allen
U. S. Steel Corp.
Aho, Lyle E.
Battles, Leon E.
Belobradich, William
Bolton, Hubert F.
*Derby, Richard A.
Fowler, Alan
Friedman, Edwin A.
Hansen, Lloyd B.
Harrison, J. H.
Johnson, Thys B.
MacAlpine, K. F.
*Savage, Alfred F.
Stewart, William G.
Waller, P. R.
No Data Supplied
Ahola, Vernon
Olson, R. L.
Unger, Harold F.
Pearson, R. B.

COOLEY

M. A. Hanna Min. Co.
Sullivan, Paul G.

CROSBY

M. A. Hanna Co.
Engel, Fred K.
Humer, Guy B.
Trost, Lawrence C.
Pickands Mather & Co.
Stetson, Harland J.
No Data Supplied
Blanch, Steve R.
*Kangas, Adam Werner
Simmons, John J., Jr.
Van Evers, J. Walbur

DEERWOOD

No Data Supplied
Chilton, Dan R.

DULUTH

Atkins-Walker Co.
*Walker, Harry C.
E. I. Du Pont De Nemours
Co.
Brown, Tom T.
Eimco Corp.
Currie, W. R. Neil
*La Grange, M. Dean, Jr.
Lien, Russell A.
Joy Mfg. Co.
Lundmark, R. J.
MacCallum, Arthur A.
Link Belt Co.
Mills, Edward L.
Morrison, John E.
Mesake Mineral Assoc.
Pearsall, Wm. G.

Minnesota-Mississippi

W. S. Moore Co.
Everett, Jack V.
Moore, Warren S.
Romanuck, Morley S.
Simon, Robert E.
Werner, Robert F.
Nelson Enterprises
Nelson, Albert O.
Nordberg Mfg. Co.
Crandall, John W.
North Western-Hanna
*Crawford, John T.
Oglebay Norton Co.
Adair, Donald L.
*Torreano, August F.
Pickands Mather & Co.
Anundsen, E. A.
Brewer, Richard
*Chisholm, Alex D.
Chisholm, D. M.
DeVane, Fred D.
Duncan, Kenneth
Royce, Josiah
Stunkard, Bruce W.
Republic Steel Corp.
*Cath, F. H., Jr.
Howell, Sidney C.
Skillings' Mining Review
Harkins, Wesley R.
Snyder Min. Co.
Rudstrom, Chas. O.
*Sundness, O. A.
U. S. Bureau of Mines
Langfield, L. Daniel
Look, Allen D.
Tenny, Roger L.
U. S. Steel Corp.
Axelson, A. Herbert
Bennett, Robert L.
Bradley, Stuart V.
Burton, Carlyle R.
Byers, Richard R.
Campbell, Lloyd S.
Connolly, Lewis P.
Cotter, Wm. E., Jr.
Duhling, W. H., Jr.
Eltad, R. T.
Erickson, William T.
Erpamer, E. C.
Johnson, Everett D.
Learnmont, Robert P.
Lopez, Roger D.
Marsden, Ralph W.
Matheson, W. N.
Morton, Ronald James
Moyle, Robert M.
Murkey, J. G.
Myers, Henry F.
Palasvirta, Oasi E.
Reid, Ian L.
Segar, R. W.
Stone, Elmer G.
Strong, Richard
Zeller, James L.
Williams, Milton F.
Zeller, George C.
Zenith Iron Min. Co.
Sellwood, Jos. G.
No Data Supplied
Adams, Robt. M.
Alworth, Royal D., Jr.
Anderson, Ernest J.
Andreacchi, John R.
Antonelli, M. R.
Congdon, Robert
*Diehl, C. E.
Dudley, Harry C.
Ferris, John A.
Hakala, Harvey J.
Higgins, Raymond J.
Hunner, Earl E.
Hustad, Jas. B.
Iverson, Cedric L.
Joppa, Everett L.
McEachin, John L.
Moberg, Norman A.
Peterson, A. Y.
*Roberts, Hugh M.
Schell, Harry L.
Schnauffer, A. E.
*Scofield, Lloyd M.
Spencer, Geo. H., Jr.
Wolff, J. F., Sr.
Young, Frank A.

ELY
U. S. Steel Corp.
Berkner, Donald A.
No Data Supplied
Bolitto, Edward C.
Dick, Leslie E.
Stepce, Steve A.

EVELETH
Eveleth Fee Office
*Campbell, Vernon R.
No Data Supplied
Hartley, David

FARIBAULT
No Data Supplied
Delaney, John F.

FINLAND

No Data Supplied
Machamer, Jerome E.

GILBERT

No Data Supplied
Kohn, Russel F.

GRAND RAPIDS

No Data Supplied
Lienke, Earl F.
Palusky, E. L.
Simon, James A.

HIBBING

C. J. Calvin & Assoc.
*Calvin, C. J.
Charleson Iron Min. Co.
Remer, Chas. H.
The Cleveland-Cliffs Iron Co.

*Foucault, John J.
Hanson, Lauren K.
Knudson, John Ronald
Pakkala, W. Al
Viant, Melvin L.
Continental Sales & Equip. Co.

Scott, Donald W.
Great Northern Iron Ore Properties
*Baehr, Richard E.
Robins, William A.
Watson, William W.

The M. A. Hanna Co.
Buck, Robert O.
Bunge, Fred H.
Glumac, George
Lipovetz, Gerald
Koski, Eino O.

Meli, C. James
*Morrow, James B.
Warhol, Warren N.
Hardinge Co. Inc.

Ferguson, R. C.
Jasper Eng. & Eq. Co.
*Jamar, Dwight W.

Jones & Laughlin Steel Corp.
*Strande, Julius A.
Lerch Bros. Inc.

Lerch, Glen B.
Abe W. Mathews Engrg. Co.
*Banke, Joseph J.
Gribble, Robert Q.

*Mathews, Abe W.
Meriden Iron Co.
*Aronson, C. W.

Stuart, James R.
Torreano, Peter F.
Mesaba Service & Supply Co.

*Taylor, W. L.
Mesabi Mineral Assoc.
Mayer, Christian J.

Minn. Div. Lands & Min.
Cicchi, David P.
O'Brian, Daniel T.

W. S. Moore Co.
Madison, J. M.
Pacific Isle Min. Co.

Beardshear, George T.
Boentje, John D., Jr.
Halstead, M. Richard, Jr.

*Harrison, Hugh H.
Hart, H. M.
Kimball, Donald

*Vellola, Anthony Thomas
Pickands Mather & Co.
Childs, Mary-Hill

Maxwell, Ellis C.
McDermott, William F.
Merkin, Kenneth E.

Rhode & Fryberger
Fryberger, William B.
Rhude, Jens O.

U. S. Bureau of Mines
Marovelli, Robt. L.
U. S. Steel Corp.

Bailey, Carlton D., Jr.
Beebe, Wayne W.
Hearding, John H., Jr.

Johnson, Marvin E.
*Koenen, A. T.
Pell, George H.

Sermon, Milton R.
Suhkonen, John A.
Van Delinder, M. D.

Vik, Richard A.
Western-Knapp Engrg. Co.
*Samuelson, B. A.

The Zeco Co.
Shefchik, David R.
No Data Supplied

Althouse, John G.
Anderson, Roger G.
Andreas, B. M.

Barber, Max H.
Bassett, R. H.
Cushen, Leo W.

Crist, Robert B.
Erickson, Stephen E.
Greenaway, N. J., Jr.

Helland, Norman G.

Howes, John R., Jr.
Koskinen, Peter K.
Kotomaa, George
Lever, Harold A.
Mattson, George A.
McElvain, R. E.
Meyers, Donald H.
Nyhus, John W.
*Pickering, H. M.
Reese, Hiram E.
Rhude, James E.
*Rockwell, S. A.
Ryan, Kenneth H.
Swennington, N. C.
Thielman, T. C.
Wallace, Robert C.
Webb, Wm. D.
Wick, Dave E.
*Wolff, Werner P.
Young, E. A.

HOYT LAKES

Erie Min. Co.
Ahlgquist, H. Richard
Barge, O. T.

Basso, John A.
Bell, Robert W.
Bymark, John V.
Carlson, A. J.

Groll, Kenneth R.
*Healy, John H.
Helge, Ellis C.

Hockin, E. Bruce
Hopland, Mark
Johnson, Earl R.

Johnson, Raymond E.
Marr, William N., Jr.
Peterson, Edward C.

*Stensrud, Roscoe
Thaler, Albert B.
Tittman, David W.

Tuttle, Wayne H.
Whaley, Henry P.
No Data Supplied

Hayden, G. Spalding
Messner, D. James
Sears, Hayden F.

Wester, F. R.
Wivell, James W.

IRONTON
Inland Steel Corp.

Olson, Lemoyne S.
Zontelli Bros. Inc.
Zontelli, Emil A.

KEEWATIN
M. A. Hanna Co.

*Whitney, R. W., Jr.
Pickands Mather & Co.
Tyler, Edwin R.

KELLY LAKE
No Data Supplied

Smedman, John

MARBLE
Great Northern Iron Ore Properties

Lehtola, Evert M.
No Data Supplied
Wilson, D. H.

MAZEPPA
No Data Supplied

Searles, John N.

MINNEAPOLIS
Apache Oil Corp.

*Adams, Salisbury
Bear Creek Min. Co.
Bailey, Paul A.

Millett, F. B., Jr.
Ingersoll-Rand
Robinson, Alan W.

Thomassen, Mark W.
The Int'l. Nickel Co. Inc.
Neemes, J. C.

Link Belt Co.
Lovrien, James K.
Lithium Corp. of America

Clark, Fremont F.
Harris, Carleton B.
E. J. Longyear Corp.

Burnhart, V. N.
Davidson, D. M.
*Donovan, Percy W.

Eastman, Walter R., Jr.
Gleason, Michael J.
*Hansen, Mayer G.

Kurtze, Harry A.
Larson, Eugene
Longyear, R. D.

*Miller, J. R.
Richmond, Stewart G.
*Sorensen, Bryan F.

Manganese Chem. Corp.
Babbitt, B. R.

Minn. Electric Steel Castings Co.
Moll, A. Donald
Meriden Iron Co.
Bennett, Russell H.
*Ferris, Wallace F.
Montana-Dakota Utilities Co.
Smith, Cecil W.

The Pillsbury Co.
Gracza, Rezaos
U.S. Bureau of Mines

Colombe, Arthur F.
Gordon, Franti E.
Grosch, Wesley A.

Lubker, Robert E.
Needham, A. B.
Vasson, Paul A.

Univ. of Minnesota
Bleifuss, R. L.
*Cooke, S. R. B.

*Gundersen, J. Novotny
Iwasaki Iwao
Petersman, Zell E.

*Pfeider, Eugene P.
*Schulz, Norman F.
*Schwartz, George M.

Wade, Henry H.
*Weaton, Geo. F., Jr.
Yardley, Donald H.

Winston Inc.
J. H. Blackmore
No Data Supplied

Bennett, T. W.
Calhoun, Allan B.
Gaarden, Alice R. W.

*Gerow, Theron G.
Hickok, E. A.
Kruger, John H., Jr.

*Lehmann, Ernest K.
*Loofbourow, R. L.
Nelson, Arthur M.

Rand, Lenox H.

MONTICELLO
No Data Supplied

Constock, Prof. E. H.

MT. IRON
U.S. Steel Corp.

Bingel, John P.
Forcier, James E.
No Data Supplied

Marincel, Geo M.

NASHWAUK
Cleveland-Cliffs Iron Co.

*LeClair, William M.
M. A. Hanna Co.
Dicks, Mason L.

Englund, Arthur E.
Faust, Herbert H.
Kauti, Eino A.

*Knapp, Vaughn
*Larson, Harry A.
No Data Supplied

*Matsun, Amos E.
Oss, Donald G.

RIVERTON
Manganese Chem. Corp.

*Peterson, Donald W.

ROCHESTER
Minn. Highway Dept.

Anderson, Neil L.
No Data Supplied
Rother, Jack S.

ST. PAUL
Amer. Hoist & Derrick Co.

Wilson, Richard W.
F. H. Bathke Co.
Bathke, A. S.

Butler Bros.
Butler, Cooley
Butler Office Inc.

Butler, Patrick, Jr.
Great Northern Iron Ore Properties
Flinn, W. C.

Ray, Philip L.
Great Northern Ry. Co.
Wollenzien, Thomas P.

Iron Ranges Nat. Gas Co.
Warhol, Peter
Minn. Dept. of Taxation

Berry, Charles W.
Minn. Div. of Lands & Min.
Nolan, Ray D.

Passos, Roy C.
Minn. Highway Dept.
Palmquist, John M.

Minn. Min. & Mfg. Co.
Cadwell, Donald E.
Collins, Robert C.

Northern Pacific Ry. Co.
*Binon, Layton C.
Carmichael, Virgil W.

*Lindgren, Donald W.
Fowe, George R.
Pioneer Min. Co.

Butler, Patrick

J. L. Shiley Co.
*S. T. Harrison
No Data Supplied
Austin, Orrin
Brown, John A.
Cahill, Robt. C.
Cochran, B. R., Jr.
Crosbie, Robert M.
Prickett, Gordon O.
*Scallion, Edward F.

SILVER BAY

Reserve Min. Co.
Bryant, J. Wm.
Cooksey, Donald E.

Davis, E. W.
Haley, Kenneth M.
Lampman, Edwin C.

Linney, Robert J.
Reed, Richard L.
No Data Supplied

Furness, Edward M.

TACONITE

Cleveland-Cliffs Iron Co.
Hill, Arnold E.

*Schausten, John W.
*Van Slyke, William R.
No Data Supplied

Randolph, Eskil R.

VIRGINIA

City of Virginia
Johnson, Peter J.
Dort-Oliver, Inc.

Keller, D. Leon
Jones & Laughlin Steel Corp.
Betzler, William F.

Durocher, R. E.
Eliertson, George A.
Fritz, Alan J.

Kruse, Paul W.
Kullberg, H. F.
Moern, R. Roger

*Stephenson, Thomas E.
Skubic Bros. Co.
*Sulemitch, Karl

U.S. Steel Corp.
Chisholm, John
Erickson, Arthur C.

*Gibbens, David D.
Hardt, Norman J.
Hendrickson, L. G.

Hill, David H.
Lerohl, Iver R.
Martin, John M., Jr.

Mielke, Morris V.
Mohr, Thomas C.
Salmi, Robert William

Schmidt, Robert L.
*Scipioni, Bruno
Oja, Ralph C.

No Data Supplied
Arpi, William A.
Bennetts, William H.

*Caddy, Howard T.
Davidson, Ferman V.
Hake, Francis D.

Handberg, Peter N.
Langer, Robert J.
Manseau, H. F., Jr.

Moore, Russell C.
Nolan, John T.
Rubow, Irvin H.

Skubic, Frank

WINONA
Brom Machine & Fdry. Co.
Brom, Leo J. T.

MISSISSIPPI

ABERDEEN

No Data Supplied
Adam, George E.

HATTIESBURG
No Data Supplied

*Brown, Bahngrell W.

JACKSON

Concrete Div., USAEWES
Mather, Katharine K.
Filtrol Corp.

Millice, Carl T., Jr.
Shell Oil Co.
Kryn, George W.

Waterway Experiment Sta.
Luke, Wilbur I.

KOSCIUSKO

Magnet Cove Barium
Menze, Richard J.

NATCHEZ

No Data Supplied
*Wells, Alonzo M.

PACE

No Data Supplied
Lum, Daniel

PICAYUNE

No Data Supplied
Hoag, Clifford

MISSOURI

BONNE TERRE

St. Joseph Lead Co.
Anderson, Seales T.
*Bartholomew, Geo. C.
Bilheimer, Lee
Brady, Bernard F.
Brown, John S.
Bullock, Richard L.
Casteel, L. W.
Choate, Lauren W.
Clark, Martin L.
Clemmons, Robert E.
Clifford, Thomas J.
Cropper, Wallace J.
Cummings, Bradford C.
Duffy, W. D.
Ferguson, Perry N.
Grayson, Gerald L.
Grout, C. MacDonald
Haug, Edward J.
Hoffman, Herbert A.
Hopler, Robert B., Jr.
Jones, Elmer A.
Kiser, John E.
Koen, Harold L.
Lane, Marvin E.
Mann, C. David
*Morton, Thomas R.
Reed, John J.
Snyder, Frank G.
Turlay, Lovell L.
Wagner, Richard E.
*Weber, John E.
Weigel, W. W.
No Data Supplied
Stockett, N. A.
Winkel, Marvin E.
Wolf, E. Hugo

CARL JUNCTION

No Data Supplied
Huddleston, Melvin

CLAYTON

Allis-Chalmers Mfg. Co.
Quinn, Joseph S.
No Data Supplied
*Dunbar, Douglas MacD.

COLUMBIA

Univ. of Missouri
Keller, Walter D.

COLLEGE PARK

U.S. Bureau of Mines
Ageton, Robert W.

DESLIDGE

Grigsby Valve Co.
Grigsby, Gail G.
No Data Supplied
Benner, Denny R.
Klosterman, Gregory
Monroe, Harley L.

DE SOTO

De Soto Mining Co.
Thompson, John Marshall

ELVINS

No Data Supplied
McCorey, Geo T.

FARMINGTON

No Data Supplied
Schumacher, R. L.

FLORISSANT

No Data Supplied
Desloge, Jos., Jr.

FORT LEONARD WOOD

U.S. Army
Bradley, R. C.
*Clark, Ronald W.
Dawes, Richard E.
Denton, David F.
Dougherty, Ralph H.
Sense, Richard G.

FREDERICKTOWN

National Lead Co.
Cooper, C. F., Jr.
Krueger, Harold A.
Morris, T. Q.
Niedermeyer, O. D.

No Data Supplied
Ellett, R. D.
Phebus, James E.
Rood, J. A.
Smith, C. T.

GLENDALE

No Data Supplied
Hicks, Thomas A.

GLENCOE

No Data Supplied
Jones, Walter M.

HANNIBAL

U.S. Steel Corp.
Henning, Michael M.
No Data Supplied
Muldrow, Howard K.

INDEPENDENCE

Missouri Portland Cement Co.
Selward, Donald J.

IRON MOUNTAIN

Ozark Ore Co.
Leney, George W.
Matson, Robert F.
Owens, John S.

JOPLIN

Amer. Lead, Zinc & Smelt. Co.
Netzeband, W. F.
Stewart, Daniel R.
Atlas Powder Co.
Ash, Richard L.
E. I. du Pont de Nemours & Co.
Cash, Robert O.
The Eagle-Fisher Co.
Atteberry, W. D.
Hamilton, Paul R.
Illidge, R. E.
General Steel Products Co.
Kirk, Whitson J.
Minerals Beneficiation Inc.
Rakowsky, Victor
Potter & Sims
Parker, Leonard
Rogers Iron Works Co.
*Nixon, Virgil H.
Schultz, Robert R.
Wm. M. Stewart Engrg. Co.
*Stewart, William M.
U.S. Bureau of Mines
Chester, John W.
Knox, Clinton C.
Bruce Williams Labs.
*Jones, Philip L.
No Data Supplied
Bendelari, Fred N.
Crowley, Allen S.
*Fowler, George M.
Gray, Howard Otis
*Lyden, Joseph P.
Plumb, Carlton H.
Potter, Geo W.
Rakowsky, Russell
Wallower, F. C.
White, Harold Henry
Williams, Bruce

KAHOKA

No Data Supplied
Northrup, Allen

KANSAS CITY

Armco Steel Co.
Bard, A. L.
Hagenbuch, Chas. W.
Souder, Arnold, Jr.
Electrofrac Corp. Inc.
*Sarapu, Erich
KW-Dart Truck Co.
Clayton, W. C.
Midwest Research Inst.
*Park, William R.
Pittsburg & Midway Coal Min. Co.
Spencer, Kenneth A.
Spencer Chemical Co.
Coolry, Charles M.
Thomas, C. Y.
U.S. Army Corps of Engineers
Audsley, Glenn L.
No Data Supplied
*Jung, Frederic W.
Kirk, Eugene J.

KIRKWOOD

No Data Supplied
McCallum, Jean

MEXICO

Miller Mining Co.
Miller, R. Lary

NORMANDY

No Data Supplied
Schaffner, C. R., Jr.

N. KANSAS CITY

Timken Roller Bearing Co.
Powers, K. W.

ORONOGO

Oronogo Mutual Min. Co.
Waring, Guy H.

PARKVILLE

No Data Supplied
Miller, Emory T.

POTOSI

Midwest Mining Co.
Hanson, William L.
National Lead Co.
Achterberg, Ernest R.
*Houk, Clarence C.
Sackett, Earl L. H.

RIVERMINES

St. Joseph Lead Co.
Vykoft, B. T.
No Data Supplied
*Fressler, Louis P.

ROLLA

Missouri Geol. Survey
*Beveridge, T. R.
Grenis, James D.
Hayes, William C.
Missouri School of Mines
*Amstutz, G. C.
Caudle, Rodney D.
*Christiansen, Carl R.
*Clark, George B.
*Crawe, Oliver R.
*Hager, John P.
*Legadin, Adolph
Ligasacchi, Attilio
Logue, Hugh Thomas
*Morgan, Ray E.
*Proctor, Paul Dean
Randolph, Earl J.
*Thompson, Dudley
Wilson, Curtis L.
Worley, Morris T.
Yancik, Joseph J.
Zimmermann, Richard A.
U.S. Bureau of Mines
Fine, Morris M.
McElvenny, L. T.
Miller, William C.
Murrill, Randall T.
Reynolds, Burton M.
No Data Supplied
Cochran, Robert W.
Schmid, Milne J.
Travis, R. G.
Wilson, Peter C.

ST. GENEVIEVE

Mississippi Lime Co.
Fieg, Lothar

ST. JAMES

Stourton Enterprises
*Stourton, George E.

ST. LOUIS

American Cyanamid Co.
Lowe, R. H.
Amer. Manganese Steel Div.
Baker, John H.
Amer. Zinc, Lead & Smelt. Co.
*Ammon, Robert
Calhoun, R. E.
Cotterill, Carl H.
Dobbel, Chas A.
*Roddewig, George W.
AZBE Corp.
Schenck, George
W. R. Bendy Cement Engineers
*Bendy, W. R.
Corps of Engineers
Haudrich, David J.
Frazier-Davis Constr. Co.
Gunther, Roy J.
*Molten, Robert P.
Gardner-Denver Co.
Bird, John C.
Hammer Mills, Inc.
*Oberhelman, T. A.
Hewitt-Robins Inc.
*Furnort, Arthur S.
Ingersoll Rand Co.
*Moulton, B. G.
Joy Mfg. Co.
*Lake, Thos. B.
Ludlow-Saylor Wire Cloth
Hogan, Virgil R.
Mine Safety Appliances Co.
*Buys, Victor W.
Minerva Oil Co.
Desloge, Joseph
Jones, Berkeley
Monsanto Chemical Co.
Emigh, C. Donald
Hurst, Thomas L.
Rumer, Robert R.

Nordberg Mfg. Co.

Propp, H. N.
Ortrac Inc.
Weidlich, Gilbert A.
H. K. Porter Co.
Hartup, Robert Rex
Peabody Coal Co.
Arnold, Cecil P.
Burkhardt, Fred R.
Cole, John T.
Elfred, F. Stillman
Kelce, Merl C.
Massmann, A. P.
McCollum, Herb C.
O'Loughlin, Ivan
Owen, Eugene E.
Weimer, Wilbur A.
St. Louis Chamber of Comm.
Kerr, John D., Jr.
St. Louis University
Blum, S. J., Victor J.
Heinrich, Ross R.
Shasta Coal Corp.
Stevens, E. F.
Carl G. Stifel Realty Co.
*Stifel, Carl G.
Surdex Corp.
*Swoboda, Raymond B.
Sverdrup & Parcel
*Bunce, Harry S.
Wm. M. Taggart & Co.
Brazil, M. P., Jr.
U.S. Air Force
Finklang, John W.
Valley Dolomite Corp.
Day, Henry P.
Donnell, Ben P.
Washington University
*Berry, Richard W.
Hinchey, Norman S.
Sharon, H. Leroy
*Tolman, Carl
No Data Supplied
Baer, George A., Jr.
*Bain, C. Kremer
Fetch, Robert M.
Frank, A. J.
George, Jules C.
Griffiths, J. R.
Hagen, Hubert D.
Harter, Ray K.
Horner, Preston K.
*Jenkins, G. Stuart
Matekar, Emil, Jr.
Neustaedter, H. A.
Peters, K.
Peugnot, A. A.
Prough, Paul B.
Stevens, Robert F.

SALEM

Bear Creek Mining Co.
Larsen, Kenneth G.

SULLIVAN

Meramec Mining Co.
*Bent, Douglas W.
Bilheimer, Earl L.
Perkins, Ralph C., Jr.

UNIVERSITY CITY

No Data Supplied
Greenblatt, Robt. F.
Neelley, Percy C., Jr.

VIBURNUM

St. Joseph Lead Co.
Redfield, Francis F.

VIDA

No Data Supplied
Bruzewski, Robert F.

WEBSTER GROVES

No Data Supplied
Ipsen, A. O.
Lake, Wilbert W., Jr.

MONTANA

ANACONDA

Anaconda Company
Banard, Enoch A.
Bollen, John L.
Davis, William B., Jr.
Day, Frank H.
Dimock, E. P.
Ferklin, Herbert C.
Fisher, Truxton J.
Forman, Donald M.
Freshour, Chester
Gale, George D.
Holderreed, Francis L.
Jeniker, Frank E.
*Kettner, Raymond V.
McCrea, J. Hollis
McDonald, Bernard T.
*Milkwick, C. F.
Miller, Robert B.
Mitchell, Fergus C., Jr.
Moore, John R.

Mississippi-Montana

Roeder, Fred A.
Stokke, Melvin A.
No Data Supplied
Frick, F. F.
Maguire, Hugh J.
Marincol, Joseph M.
Ruckwardt, Kurt F.

BILLINGS

U.S. Geological Survey
Lerwill, Joseph R.
No Data Supplied
Albin, B. R.
Foster, W. B.
*Johnson, Clarence J.
Platt, Frederick C.

BOULDER

No Data Supplied
Criswell, Wilbur F.

BOZEMAN

Gold Reserve Mining Co.
*Garwood, Robert G.

BUTTE

Anaconda Company
Ash, Samuel
Bonner, Edward O.
*Borchardt, Edward R.
*Bossard, Floyd C.
Donner, Donald L.
Droubay, Juel G.
*Gidel, Muri H.
Goddard, Charles C., Jr.
Grunig, James K.
Guilbert, John M.
*Hannifan, Martin K.
Hicks, Clifford J.
*Hunt, Homer M.
*Ingersoll, R. G., Jr.
Karinen, Bruce
Larsen, Wallace L.
Lee, Ian
*Matthews, Chas. S.
*McAleer, Joseph F.
McCanna, Marcus E.
Norem, William C.
Peterson, Edward M.
Piper, R. Davidson
Pledson, W. O.
Renourd, E. I., Jr.
Shea, Edward F.
Steele, Chester H.
*Stewart, Richard MacLin
*Strandberg, Fred W.
Tierney, Edward D.
Wendel, Herbert A. J.
Zeihen, Lester G.
The Archibald Co.
Archibald, James K.
Boland Develop. Co., Ltd.
Young, Herbert G.
General Electric Co.
Richard, Lloyd H.
Hammond-Everly Engrg. Co.
*Everly, Walter F.
Kenwood Realty Co.
*Wise, T. Chas.
Mont. Bur. of Mines & Geol.
*Sahinen, Uno M.
Mont. School of Mines
Arani, A. E.
*Cox, Willard E.
*Crowley, Francis A.
Earl, Fred N.
*Jordan, Theodore S.
*March, W. S., Jr.
McAniff, D. Charles
*McGlashan, D. W.
*Stout, Koehler
*Vine, William A.
Wayment, William R.
Rusken Mining Co.
*Judd, Kenneth M.
U.S. Dept. of Justice
*Bookey, Jack H.
Westinghouse Air Brake Co.
Rontz, Dietrich H.
Westinghouse Electric Corp.
*Clapp, Glenn H.
No Data Supplied
Aikin, Wilbur O.
Antonelli, Frank M.
Bishop, L. F.
Boulter, George W.
*Bowsher, John A.
Briney, William J.
Brown, Ray O.
Carveth, Charles C.
Champ, Clarence A.
Dougherty, John F.
Driscoll, James E.
Farmin, Jeremy C.
Geach, Robert D.
Goddard, Bruce B.
*Griswold, Geo. C., Jr.
Hammond, Roy M.
Hendrickson, Ida D.
Home, Robert D.
Jaccard, F. C.
Johnson, H. F.
Leggatt, Alexander
Linfirth, F. A.

Montana-Nevada

Lukins, Thomas C.
Obrien, W. A.
*Peyton, Sidney Burns
Richardson, Allan S.
Sales, Reno H.
Suttie, J. M.
Tolonen, A. W.
Treweek, Harold B.
Truworthy, Ed B., Jr.
Unger, W. H.
Warren, John W.
Weiner, Robt. C.
Wilk, R. S.
Williamson, William
Wright, Morgan Harvey
Young, Francis M.

COLUMBIA FALLS

Anaconda Aluminum Co.
Hanson, George T.
Kraft, Paul H.
Sneddon, R. A.

COLUMBUS

No Data Supplied
Gaethke, F. P.

DARBY

Cummings-Roberts Darby
Fluor.
*Taber, John W.

DEER LODGE

No Data Supplied
Martin, Thomas W.

DILLON

Hand Mines
*Hand, William M.

EAST HELENA

American Chemet Corp.
Porter, William H.
A. S. & R. Co.
*DeLude, Chas. T.
Loughridge, K. D.
No Data Supplied
Cox, William R.

GARRISON

Montana Phosp. Prod. Co.
Bell, Leslie V.
Burnet, F. E.
*Hendricks, Donald A.
Utah Const. Co.
*Smith, Donald C.

GREAT FALLS

The Anaconda Co.
Alf, Alfred I.
Baltzer, Robert H.
Cadwell, G. M.
DeArmond, Charles F.
Mukavitz, David R.
Villeneuve, M. J.

HEATH

U.S. Gypsum Co.
Shahan, William C.

HELENA

Mont. State Highway Comm.
*Matthew, Richard R.
No Data Supplied
Cloe, Lyle F.
Collins, Ted E.
Miller, Richard N.
*Nelson, Robert H.

LEWISTON

No Data Supplied
Dickman, Duane
Long, Bernard G.

LIBBY

Zonolite Co.
Calkins, John B.

LIVINGSTON

E. J. Preston Asso.
*Twinn, Joseph Conrad

MARYSVILLE

No Data Supplied
*Wade, William Rogers

MISSOULA

No Data Supplied
Walters, Ray E.

NYE

American Chrome Co.
Bley, John
Capie, William G.
Harris, Dwight L.
Hsieh, Wm. H.
Lukens, John L.
Stanford, Jas. V.
No Data Supplied
Clayton, Robert L.

PHILIPSBURG

Taylor-Knaapp Co.
*Knaebel, Charles P.
Taylor, Alvin V., Jr.
No Data Supplied
Johnson, D. S.
Owsley, Fred
Regan, Martin D.
Walkup, Albert C.

RAMSAY

No Data Supplied
Gluck, Geo. S.
Ripley, Paul M.

ROUNDUP

The Roundup Mining Co.
Johnson, Walter J.

SNIDER

No Data Supplied
Kirkenberg, Knute, Jr.

STEVENSVILLE

No Data Supplied
Evans, James R.

TRIDENT

Ideal Cement Co.
*Brown, Brinton C.

WHITEFISH

No Data Supplied
Dixon, Wallace J.

NEBRASKA

OMAHA

Condon-Cunningham Co.
*Dirks, George E.
Union Pacific Coal Co.
Bayless, I. N.
No Data Supplied
Gier, Donald E.
McAuliffe, Eugene

RIVERTON

No Data Supplied
Ziegler, Jay R.

SIDNEY

No Data Supplied
Nissen, 2nd Lt. William I.

NEVADA

AUSTIN

New Pass Mine
*Jung, Donald E.

BATTLE MOUNTAIN

Bootstrap Mine
Fisher, M. S.
Magnet Cove Barium Corp.
Seldin, Marvin B.
No Data Supplied
Hoalst, Blaine C.

BLUE DIAMOND

Blue Diamond Corp.
*Cain, J. H.
Waldhausen, H. L., Jr.
*Wells, Herbert C.,
No Data Supplied
Brooks, Marion C.

BOULDER CITY

No Data Supplied
Dieleman, Jake W.
Mead, Tom C.
Ray, D. M.

CARSON CITY

Dayton Cons. Mines Co.
*Weideman, Robert R.
Nevada State Engr.
Dondoro, F. N.
*Muth, Edmund A.

No Data Supplied
Bernard, Arthur E.
Larsh, Walter S.

ELKO

Mt. City Uranium Co.
Radley, Otto C.

ELY

Ely Gold Mining Co.
*Walker, William J.
F. W. Millard & Son
Millard, F. W.
Prospector Labs
*Berge, Byron T.
No Data Supplied
Coulthard, John F.
Zunino, John

EMPIRE

U.S. Gypsum Co.
*Devitt, William
Paulsen, John C.

EUREKA

Eureka Corp.
*Breckenridge, Robert N.
Eureka Corp. Ltd.
*Faroni, Walter A.
Mitchell, George W.

FALLON

No Data Supplied
*Meador, Keith N.
Malone, Kevin

GABBS

Basic, Inc.
Cabill, Thomas M.
Dixon, Augustus M.
Hanson, Norman E.
*Sullivan, George L.
Sutton, Raymond E.
Willard, H. P.
Gabbs Exploration Co.
Dougan, Lee D.
Standard Slag Co.
Evanovic, Mike
Gaylord, G. B.
Gilroy, U. B.
Jones, Robert O.
Maher, William C.

GOLCONDA

Getchell Mine, Inc.
*Newman, William J.
*Nojima, Tetsuo Roy

GOODSPRINGS

Wild Rose Mining Co.
*Blake, Wilson

HENDERSON

American Potash & Chem.
Corp.
*Sawyer, Dwight L., Jr.
Basic Management Inc.
Park, Edwin F.
Howe Sound Co.

MANAGAMESE, INC.

*McCarroll, Sidney J.
Blake, Robert A.
Campbell, John B.
Gates, Ellis H.
Hawkins, Charles S.
*Howard, Victor T.
Kendrick, W. L.
Stauffer Chemical Co.
*Newell, Arthur T.
Titanium Metals Corp. of Amer.
Eck, Lawrence T.
Pope, Charles R.
Rosenberg, Harry
Wardlaw, Tom L.
U.S. Lime
MacDonald, John C.
No Data Supplied
Love, Frank E.

KIMBERLY

No Data Supplied
Miller, Charles E.

LAS VEGAS

Clary Wilkie Assoc.
*Clary, Ernest H.
C. P. Keegel, Engrs.
*Keegel, C. P.
Nevada Testing Labs, Ltd.
Scherer, O. J.
Reynolds Elect. & Engr.
McGregor, Donald R.
Root Zinc Min. Co.
Fayle, Leonard R.

Wells Cargo, Inc.
Sharp, J. Frank
Wells, J. W.
No Data Supplied
Brown, W. M.
Byrnes, James L.
Hezzelwood, L. L.
Klein, Mark J.
*Nelson, Harry E.
Sacrison, C. R.

LOVELOCK

Eagle-Picher Co.
*Spencer, E. L.
Mineral Materials Co.
*Leidich, Peter W.
U.S. Gypsum Co.
Stockton, John D.

MC DERMITT

Cordero Mining Co.
Fisk, Elwin L.
No Data Supplied
Sorensen, Paul M.

MC GILL

Kennecott Copper Corp.
*Burrill, Scott L.
Gunter, Donald R.
Kinneer, John C., Jr.
Lawrence, F. A.
O'Shaughnessy, M. J.
Schutta, Francis C.
Smith, John G.
No Data Supplied
Denny, Iere Robert
Draper, Elwin V.
Markette, F. J.

MERCURY

Lawrence Radiation Lab.
*Lorber, Harvey R.
Reynolds Elec. & Eng. Co.
*Flanagan, Wm. G.
*Nickson, Alex E.
*Zerfoss, George F.

MINA

No Data Supplied
*York, Bernard

OVERTON

West Coast Silica Co.
*Moriedge, Fred L.

PIOCHE

Atlanta Gold & Uranium Co.
Collins, Clyde E.
Bristol Silver Mines Co.
*Hardie, Byron S.
Combined Metals Reduction Co.
Lee, Reginald G.
Perkes, E. S.
Swanson, Henry E.
Pioche Mines Cons.
Janney, John
No Data Supplied
Scott, Albert L.

RENO

The Anaconda Co.
Jones, John Kenneth
Wilson, James R.
Cooke, Everett Assoc.
*Cooke, H. R., Jr.
Eagle-Picher Co.
Kennedy, John W., Jr.
*Steinheimer, Milton
Getchell Mine, Inc.
Hardy, Roy A.
Isbell Const. Co.
Barkley, James R.
*Isbell, C. V.
*Krupp, Luther M.
Bureau of Land Mgmt.
*Hollingsworth, Edgar A.
Nevada Mineral Labs, Inc.
*Parker, J. Ben
Nevada Porphyry Gold Mines
Inc.
*Gordon, Louis D.
Segerstrom & Heizer
Heizer, John M.
Siskon Corp.
Chesser, H. B., Jr.
Chesser, H. B., Sr.
Union Carbide Nucl. Co.
Galli, Peter E.
Morgan, James E., Jr.
Vitz, Howard E.
University of Nevada
*Beal, Laurence H.
*Butler, John N.
*Gianella, Vincent P.
*Hammond, Claude W.
Horton, Robert C.
Nelson, Harve P.
*Scheid, Vernon E.

*Slemmons, David Burton
Swan, Willis A., Jr.
U.S. Atomic Energy Comm.
Schwartz, Roland J.
U.S. Bureau of Mines
*Engel, A. L.
Long, Albert E.
U.S. Dept of Int.
*Ricker, Spangler
No Data Supplied
Adams, Clark N.
Adams, Roderick W.
Austin, W. G.
Bible, Alan
Carpenter, Jay A.
DeLongchamps, F. J.
Evans, Robert K.
Gomes, John M.
*Hart, James P.
*Hartley, Gerald B., Jr.
*Hill, Starr, Jr.
*Holmes, George H., Jr.
Johnson, A. C.
Johnston, W. P.
Laughton, George L.
Lawrence, Edmond F.
Lewis, Ezra H.
*Liddell, Parker

RENO

No Data Supplied
*Lohse, Fred
Martin, Conrad
McGirk, Lon S., Jr.
Mecham, F. J.
*O'Connor, Arthur J.
Rice, Andrew C.
Richardson, Warren B.
Richardson, Warren V.
*Ricker, O. Perry
*Schrader, Erich J.
Sheahan, Benjamin H.
*Silver, Albert
Smith, Alfred Merritt
Spitzer, R. B.
*Stephenson, Edgar L.
Temp, Edward W.
Van Gilder, K. L.
*Van Voorhis, B. W., Jr.
Wells, Howard A.
Weyler, Paul A.
Wigglesworth, R. M.
Wingfield, George

ROUND MOUNTAIN

Round Mt. Gold Dredge
*Ashley, J. H.

RUTH

Kennecott Copper Corp.
Larsen, Reuben D.
Bauer, Herman L., Jr.
Cooper, James J.
Smith, Billy B.
No Data Supplied
McBeth, Joseph D.
Nispe, Raymond C.

SILVER CITY

No Data Supplied
Donovan, Wm. M.

SILVER PEAK

U.S. Milling & Min. Corp.
*Reed, George F.

SPARKS

No Data Supplied
Combs, Roswell
Smith, Vaughn T.

TONOPAH

No Data Supplied
*de Carbonel, W. L.
Vollendorf, W. C.

TUNGSTEN

Nevada-Massachusetts Co.
*Caldwell, J. R.
Groning, Ralph L.
Nash, Eldridge
*O'Keefe, Daniel A.

VALMY

No Data Supplied
Taylor, C. M.

WEED HEIGHTS

The Anaconda Co.
Burch, Henry R.
Campbell, Robert L.
Clemens, Thomas F.
Gill, Donald K.
Gould, A. J.
Greene, Thomas A.
*Jacky, Howard W.

Keith, Frank A., Jr.
MacKenzie, A. E., Jr.
*Miller, A. E.
*Moninger, Frank M.
No Data Supplied
McMahan, Jack E.

WELLINGTON

No Data Supplied
Annett, Norman T.

WINNEMUCCA

Baldwin Mercury Mine
Baldwin, Herbert W.
No Data Supplied
*Hutton, W. Alexander
Price, M. E.

YERINGTON

The Standard Slag Co.
Harmon, John R.

NEW HAMPSHIRE

CLAREMONT

Joy Mfg. Co.
Cooney, Edwin W.
Curtis, J. C.
Goodrich, R. H.
Osgood, R. C., Jr.
Starbuck, David L.
No Data Supplied
Smith, Duray

CONCORD

No Data Supplied
Pitts, Parker De S.

FRANKLIN

No Data Supplied
Alexander, Wm. J.

GOFFSTOWN

No Data Supplied
Hobby, Edgar N., Jr.

HANOVER

No Data Supplied
Stolber, R. E.

KEENE

Whitehall Co. Inc.
Verplanck, P. B.

SALEM

No Data Supplied
*Chase, Leonard R.

NEW JERSEY

BASKING RIDGE

No Data Supplied
Owens, David W.

BLAIRSTOWN

No Data Supplied
Kynor, Herbert D.

BOONTON

Norda Ess. Oil & Chem. Co.
Amaducci, Louis

BOUND BROOK

Viking Co.
*Luty-Lutenko, Alex
Research-Cottrell Inc.
Schork, John E.

BRANCHVILLE

Willis, Paul & Proctor Inc.
*Willis, Sherred

BURLINGTON

U. S. Pipe & Frdy. Co.
Schub, A. E.

CALDWELL

Fenwick Machinery Inc.
Fenwick, Paul

CAMDEN

No Data Supplied
Jordan, Marcus C.

CARLSTADT

No Data Supplied
Dwyer, Thiel E.

CARTERET

Amco Res. Inc.
Symonds, J. MacLaren

CHATHAM

No Data Supplied
Evans, W. F.

CLIFFSIDE PARK

No Data Supplied
Burke, Paul

CLIFTON

Magnetic Engrg. & Mfg. Co.
Ferris, J. J.
No Data Supplied
Jackson, Reuben U.
Ostetk, E. S.

CRANFORD

No Data Supplied
Costanzo, F. X.

DENVILLE

Thiokol Corp.
*Mock, Allen G.

DOVER

Alan Wood Steel Co.
Kerttu, John P.
Meyers, Laurence V.
Piscatinny Arsenal
Doyle, Walter J.
Shahmoon Ind. Inc.
Kamener, Basil
*Soussa, Maurice
No Data Supplied
Brophy, Martin J.

DUNELLEN

No Data Supplied
Weiss, Edwin M.

E. ORANGE

No Data Supplied
Berglund, Robert H.
Rodgers, A. T.

ELIZABETH

Georgia Kaolin Co.
Murray, Haydn H.
James Equipment Inc.
*James, U. S., Jr.
Metals Disintegrating Co.
Noel, Don O.
Victaulic Co. of Amer.
English, Richard W.
Yara Engrg. Corp.
*Kilcarr, Gilbert M.

ENGLEWOOD

No Data Supplied
*Burris, Michael M.
Loveman, Michael H.

ESSEX FELS

No Data Supplied
Bartholomew, George P.

FAIR LAWN

Fairlawn Bd. of Education
Sappelli, Richard J.

FANWOOD

No Data Supplied
Partridge, P.

FAIR HILLS

No Data Supplied
*Queneau, A. L. J.

FLEMINGTON

No Data Supplied
*MacFarlane, J. K.

FORDS

No Data Supplied
Shimko, Joseph

FRANKLIN

N. J. Zinc Co.
Callahan, Wm. H.
Haight, Clarence M.

No Data Supplied
*Marlowe, Sherwood V.
McKechnie, D.

GREAT MEADOWS

No Data Supplied
Zima, Pavel

HACKENSACK

The Gregg Co., Ltd.
Gallit, E. Henry
Metronic Eng. Co., Inc.
Leitner, Adolph F.

HACKETTSTOWN

No Data Supplied
Sadlon, Joseph

HAMPTON

No Data Supplied
Burke, Jack J.

HAWORTH

No Data Supplied
Nunlist, Marshall B.

HOBOKEN

West & Associates
West, Woodrow W.

JERSEY CITY

Leonard J. Buck Inc.
Buck, Leonard J.
Hoguet, Joseph P.
The Galigher Co.
Black, Cyril L.
Miller, Jack S.

KENILWORTH

Adamas Carbide Corp.
Fischer, Albert J.

LAMBERTVILLE

No Data Supplied
Rider, William L.

LEONIA

No Data Supplied
Bohn, Charles A.

LINWOOD

No Data Supplied
Gilman, Walter

MADISON

No Data Supplied
Shoaf, Charles D.

MAHWAH

Amer. Brake Shoe Co.
Smith, Frank W.
No Data Supplied
Avery, Howard S.

MANVILLE

Johns-Manville Corp.
Blair, Laurence R.
*Cummins, A. B.
Kadey, Frederick L., Jr.
*King, Herbert L.
Streib, William C.

MAPLEWOOD

No Data Supplied
Koch, Eugene

MATAWAN

No Data Supplied
Meyjes, F. L.

MENLO PARK

Min. & Chem. Corp. of Amer.
*Greene, Ernest W.
Smith, Homer A.

METUCHEN

No Data Supplied
*Kemp, L. W.

MILLINGTON

No Data Supplied
Scheick, Edmund H.

MINE HILL

Alanwood Steel Co.
Usinowicz, Stanley J.

MONTCLAIR

No Data Supplied
Graddon, F. C.
Huber, Charles F.
Osgren, Gottfrid L.
Sawyer, Geo. P.

MOORESTOWN

No Data Supplied
Odence, I.

MORRISTOWN

Houdaille Const. Mat. Inc.
Hankin, Montague, Jr.
Pittsburg & Shawmut Coal Co.
Peters, James W.
No Data Supplied
*Cromwell, Robert H.
Getz, Albert J.
Karchmer, Nathan K.

MOUNTAIN LAKES

National Lead Co.
*Stewart, Alex

MOUNTAINSIDE

No Data Supplied
Sigler, Glenn E.

MT. HOPE

Shahmoon Ind. Inc.
*Hagerman, R. M.

NEWARK

Hartmann Coal Min. Co., Inc.
Hartmann, Waldemar
Lubriplate
Tiernan, James B.
Prudential Ins. Co. of Amer.
*Zavico, Basil B.
Union Carbide Corp.
Fleming, David H., Jr.
Rolseth, Harold C.

NEW BRUNSWICK

Rutgers Univ.
*Lodding, William
Smith, Bennett L.
No Data Supplied
Hammell, Laurence

NEWFIELD

Shieldalloy Corp.
*Clymer, W. Bruce

NEW PROVIDENCE

No Data Supplied
Morgan, R. H.

NORTH HACKENSACK

Compressor & Rock Service
Corp.
*Devitt, Martin E.

NORTH PLAINFIELD

No Data Supplied
Lynd, Langtry E.
Martinez, Edward
Reid, John W.

OAKLAND

No Data Supplied
Houkom, Duane A.

OGDENSBURG

No Data Supplied
*Hastings, Warren

OXFORD

Alan Wood Steel Co.
Fyfe, Lawrence
McInerney, Robert M.

PARAMUS

Atlas Copco. Eastern Inc.
Corrigan, G. H.
No Data Supplied
James, Martin A.

PASSAIC

Hewitt-Robins Inc.
*Asman, Arnold W.
*Rimeester, Henry J., Jr.
Ross, Hamilton M.
Raybestos-Manhattan Inc.
Arguedas, Arthur
Sika Chemical Corp.
Scheidt, Dr. Emil
*Sommerfield, Theodore E.

Nevada-New Jersey

U.S. Rubber Co.
Spoerl, Robert E.
No Data Supplied
Greene, Enoch F.

PENNINGTON

No Data Supplied
Widmer, Kemble

PERTH AMBOY

Int. Smelt. & Ref. Co.
*Brady, Frank H.

PHILLIPSBURG

Ingersoll-Rand Co.
Dean, Robert C., Jr.
Shepherd, B. F.
Shahmoon Industries
*Palombo, J. C.

PLAINFIELD

No Data Supplied
Popp, Alan W.
Rude, William J.

PRINCETON

Roger Williams Tech. & Econ.
Serv. Inc.
*Gibson, Kenneth H.
Princeton Univ.
*Bonini, William E.
*Kallio, J.
*Sampson, Edward
*Thom, W. J., Jr.

RIDGEFIELD PARK

No Data Supplied
Sies, John R.

RIDGEWOOD

No Data Supplied
Dickey, G. D.
McEwen, R. J.

RIVEREDGE

No Data Supplied
Vandenberg, Jacob

ROSELLE

The Austin Co.
Brand, Edward S.
Ingersoll-Rand Co.
Aldridge, Walter V.

SCOTCH PLAINS

No Data Supplied
Heiman, David
Ratliff, R. H.
*Wroth, James S.

SHREWSBURY

No Data Supplied
Hymer, H. G.

SOUTH AMBOY

National Lead Co.
Alessandrini, H. Y.
Anderson, Wm. W., Jr.
Cole, Sanford S.

SOUTH PLAINFIELD

Amer. Smelt. & Ref. Co.
Haagensen, R. B.
Kranz, Paul J.

SOUTH ORANGE

No Data Supplied
Stanwick, Charles A.

SPARTA

No Data Supplied
*Myners, Thomas F.

SPRINGFIELD

No Data Supplied
*Worthington, Joseph E.

SUMMIT

Arrow Corp.
*Jungersen, Thoger G., Jr.
Celanese Corp. of Amer.
Clarke, Charles M.
No Data Supplied
*Bell, Harold S.
Marble, Earle R., Jr.

New Jersey-New York

TEANECK

Ledoux & Co., Inc.
Adkins, Robert C.
*Bowden, William C.
Ledoux, Louis Pierre

TENAFLY

No Data Supplied
*Lilley, Ernest R.

TRENTON

S. G. Frantz Co. Inc.
*Frantz, Samuel Gibson
N. J. Geological Surv.
Markewicz, Frank J.
*Parrillo, Daniel G.
United Clay Mines Corp.
*Caine, Richard J.
Guenther, Wm. F.
Lee, Gordon W.
Peck, Douglas H.
Victor Chem. Works
Derick, C. G., Jr.
No Data Supplied
Johnson, M. E.

UNION

Air Reduction Co., Inc.
*Crowe, John J.

UPPER MONTCLAIR

No Data Supplied
Faulkner, R. H.
Roebuck, John H.

VINELAND

No Data Supplied
*Osborn, Franklin
Skinner, W. V.

WALDWICK

No Data Supplied
Brown, Ralph L.

WESTFIELD

No Data Supplied
Corbett, Clifton S.
Edson, Thomas F.
Gruner, Frederick R.
Rosa, R. H. C. Le B.
Stiefken, Chas. E.

WEST NEW YORK

No Data Supplied
Pellicciotto, T., Jr.

WEST ORANGE

McGraw-Edison Co.
Weeks, Robert H., Jr.
Philip S. Miller & Assoc.
*Miller, Philip S.

WHARTON

Alan Wood Steel Co.
Keats, Wilfred J.
No Data Supplied
Christy, Harold J.
Hovarth, M. J.

WOOD RIDGE

Curtiss-Wright Corp.
Tilison, Benj. F., Jr.

NEW MEXICO

ALBUQUERQUE

A. C. F. Industries Inc.
*Matuszski, Richard A.
Beard and Bogart
*Brown, H. Gasaway, III
Central New Mexico Equip. Co.
*Garcia, John A.
Chapman, Wood & Griswold
*Chapman, Edward P., Jr.
*Griswold, Gilbert R.
Perelli, R. J.
*Wood, John A.
Colo. Mines & Metals Co.
Chase, Edward T.
Kernac Nuclear Fuels
Hatfield, K. G.
E. J. Longyear Co.
Tucker, Edwin G.
Lovelace Foundation
*Taborelli, R. V.
Stanley & Wright
*Hall, Leroy E.
U. S. Corps of Eng.
*Bunn, Clinton O.
U. S. Forest Service
Tragitt, E. Rowland

University of New Mexico

*Kelley, Vincent C.
No Data Supplied
Anderson, C. F.
Ashlock, Walter T.
Baca, Florentino B.
*Birdseye, Henry S.
Boyd, Thomas A.
Brown, E. W.
Buzalini, Arnold
Carlson, D. H.
Colman, Hugh C.
Devillers, Wm. B.
Goldsmith, Louis H.
*Haley, Fred S.
Hardin, M. M.
Hawn, George
Hostetter, G. E.
*Leland, George R.
*Thorne, Thomas J.
Warner, George A.
Wright, Wilford S.

BAYARD

U. S. Smelt. Ref. & Min. Co.
Glover, G. T.
No Data Supplied
Newell, Oliver J.

CARLSBAD

Duval Sul. & Pot. Co.
Borskey, J. W., Jr.
Li, Hon Chi
McGuire, B. F.
Taylor, Randall H.
Tong, Jerry E.
Farm Chemicals Resour. Dev. Corp.
Hicks, Charles W.
Kindsvater, E. F.
International Minerals & Chem. Corp.
Dancy, W. B.
Davis, Farlow C.
Gordon, John D., Jr.
Houghland, Robert W.
*Ivy, J. G.
Kartchner, M. W.
*Mitterer, Adolph V.
Pressnell, C. E.
Skinner, E. C.
Stoutenger, Allan D.
*Watkins, Dick R.
Joplin Machy. & Elec. Co.
Reynolds, J. V.
National Potash Co.
Ferguson, T. G.
Potash Co. of Amer.
Baumann, William F.
Clark, Houston N.
*Coope, G. F.
Corbin, Lawrence P., Jr.
Cummings, Joseph B.
Dabney, Robert R.
Davis, F. O.
Fritschy, J. Melvin
Haworth, Russell
Koff, Raymond R.
Pinkerton, R. G.
Schaefer, Richard H.
Schoel, Edmund A.
*Schreiner, Paul E.
Rio De Oro Uranium Mines Inc.
Schultze, Raymond L.
Southwest Potash Corp.
Downey, Joseph Marshall
Herbert, Ira A.
Zandon, V. A.
Union Industrial Corp.
O'Kelley, J. C.
U.S. Borax & Chem. Corp.
*Christo, Sam, Jr.
Heaton, Geo. A.
Libbey, Donald L.
McCollum, Virgil O.
McFall, Charles G.
McGivney, Thos. F.
McWhorter, Wm. S.
Miller, Earl H.
*Schenck, Roswell D.
Tillotson, L. A.
Wright, John S.
Wertheim Agency Inc.
Sparks, Norman E.
No Data Supplied
Abernethy, Chas. W.
Allport, R. H.
Almy, A. L.
Bourne, Douglas J.
Bunzel, L. H.
Carr, Louis B.
Childers, Charles E.
Clark, Howard P.
Conder, L. Stevens
Cramer, T. M.
Erskine, Neil M.
Gant, Joseph E., Jr.
Gasparich, J. J.
Hager, James W.
Harley, C. T.
Harrison, Marvin H.
Jackson, A. S.
Johnson, Franklin E.

DEMING

Burro Chief Mines Inc.
*McCray, Hugh E.
No Data Supplied
Cannizzo, John
Deckert, Joe A.
Ingle, Hugh C., Jr.

EL PRADO

No Data Supplied
Hurley, Daniel D.

FARMINGTON

Atlas Powder Co.
*Budddecke, Donald B.
San Juan Gravel Prod. Co.
Hargrove, Don
Utah Construction Co.
Evans, Hugh W.
Recktenwald, H. J.
Smith, Frederick L.
No Data Supplied
Smouse, De Forrest

GALLUP

U.S. Army
*Scott, Carroll T.
No Data Supplied
Mouat, Malcolm M.
Coffey, William G.

GRANTS

Anaconda Co.
Arlin, Zana Earl
Balentine, Floyd J.
Beck, Theodore R.
Cook, F. Stearns
Ferguson, Donald R.
*Galloway, Torrence D.
Glover, J. Harvey
*Kittel, Dale F.
Matthews, Dale C.
Packer, Edson R.
Pate, Jack R.
Peterson, E. Clarence
Pickwick, Fred, Jr.
Roberts, Wm. J.
*Schlosser, Robert B.
Veeder, Arthur E.
Zundel, Weldon F.
Anderson Development Co.
*Jenkins, R. W.
Calumet & Hecla Inc.
*McKereghan, George F.
Weege, Randall J.
Four Corners Explor. Co.
Barry, L. D.
*Rasaport, Irving
Grants Clinic
*Ritter, Norton R., M.D.
Homestake Mining
Allen, Eugene S.
Daugherty, Maxwell
DeJong, Leonard C.
*Delicate, Donald T.
Derrer, Homer A.
*Garman, Clyde N.
Graber, E. A.
Jones, Jack O.
*Madsen, Roger A.
Osborn, Clyde E.
Rizzi, Theo. M.
Shields, Elmer R.
Soma, John L.
Steele, Robert M.
Stoehr, R. J.
Swent, Langan W.
Tomerlin, Marcus M.
Wesley, John R.

Kernac Nuclear Fuels Corp.
Ashby, Harve I.
Bartell, Henry L.
*Carlson, Donald O.
Cobb, George H.
Dolezal, Wayne R.
Gobeau, Arthur E.
Gunn, Robert M.
Hart, Victor L.
*Kuck, David L.
*O'Brien, Robert D.
Patrick, Roger B.
Robinson, Joe T.
Sallee, Graydon L.
Stanley, Charles F.
Swales, John M.

*Von Moss, Edward
Woody, R. J.
Phillips Petro. Co.
Caywood, Roger M.
Everts, Jason E.
Owen, James R.
Russell, Bruce E.
Plateau Hardware Inc.
Manson, G. W. Jud
Rio De Oro Uranium Mines Inc.
Collins, William D.
*Powers, Harold A.
Schweitzer, Donald R.
*Tuberville, Derwin D.
U.S. Atomic Energy Comm.
*Grutt, Eugene W., Jr.
Speal, Alex J.
No Data Supplied
Bee, Jack P.
Connell, Matt A.
Covert, J. D.
Gould, Walter R.
Harper, Aaron V.
Isern, Elmer
Keil, Howard R.
Kelley, Chas. W., Jr.
Larson, Alan H.
Lomas, R. E.
Maguire, James H.
Mathis, Gerald C.
McMillan, G. A.
Miller, Gerald L.
Moulton, Wesley G.
Ober, Fred N.
Palmer, William A.
Pascoe, Richard F.
Pearson, John E.
*Tipton, William D.

HACHITA

Gibraltar Min. Co.
*Jordan, Lou D.
Twitchell, C. L.

HANOVER

N. J. Zinc Co.
Snell, C. C.
Peru Mining Co.
*Faust, Jerry W.

HOBBS

No Data Supplied
Day, Robert J.

HURLEY

Kennecott Copper Corp.
Ballmer, Gerald J.
Conley, Leslie, Jr.
Brubaker, Joseph J.
Graves, Henry E.
Lenke, Paul A.
Quay, J. H.
Richardson, James K.
Schroer, Edw. A.
Slover, Edwin A.
Winn, Howard
No Data Supplied
Boise, Otis W.
Dow, Wesley Carlos
Esparaza, Hector J.
Ganley, Robert D.
Jacobs, B. C.
Lawrenz, Walter R.
Melton, E. O., Jr.
Tipolt, Thomas Jr.

LAGUNA

A. C. M. Co.
Herndon, John F.
Amer. Metal Climax Co.
Matsen, Edward

LORDSBURG

Banner Mining Co.
*Johnson, Fred Elton
Wood Mining Co., Inc.
*Wood, Ray C.

LOVINGTON

No Data Supplied
Hanners, Jerome T.

PREWITT

A. T. & S. F. Ry. Co.
Evans, T. O.
No Data Supplied
Doie, Henri E.
Zwicky, Everett E.

ROSSELL

Shelton-Warren Oil Co., Inc.
Seeton, Ross V., Jr.
U.S. Army
*Leslie, George R.

RUIDOSO

No Data Supplied
Kannaday, H. F.

SANTA FE

S. H. Glassmire & Assoc.
*Glassmire, S. H., Jr.
Green River Oil Co.
Ward, Jack B.
Klaner & Assoc.
Pollock, Martin W.
New Mexico Mining Assn.
Darmitzel, Wm. F.
W. Carlos Powell
Umboltz, Willis E.
Sabre-Pinson Corp.
*Craigie, Hugh M.
San Pedro Mines Group
*Williams, Charles F.
No Data Supplied
Dotson, Willis Leon
Matson, J. T.
Moses, Horace

SANTA RITA

Kennecott Copper Corp.
Adkins, William E.
Brockman, James H.
*Colbert, Frank A.
Dow, Wallace T.
*Matthews, Rex E.
McNaughton, David D.
Schmidt, Donald W.
*Shilling, Robert W.
Tipton, Arthur W., Jr.
*Wilmet, Howard A.
No Data Supplied
Baltosser, Will W.
Cummings, Donald F.
Nichols, B. W.

SHIPROCK

Kerr McGee Oil Ind. Inc.
Shaw, Merle N.
Stevens, Billy
Taylor, Gordon D.

SILVER CITY

Black Hawk Cons. Mines Co.
*Wright, Ira L.
No Data Supplied
Altman, Clyde R.
Boise, David W.
*Bosworth, A. M.
Davis, Richard R.
Elayer, Carl S.
*Holmquist, Ray J.
Porterfield, Melvin
*Schmitt, Harrison A.
*Shantz, Ben
Spivey, Rupert B.
Taylor, Joseph H.
Whitcomb, C. C.
Word, W. C., Jr.

SOCORRO

New Mexico Bureau of Mines
Austin, Carl F.
*Bhappu, Roshan B.
Griswold, G. B.
*Schilling, John H.
New Mexico Inst. of Min. & Tech.
Berthoff, Wm. E. II
Clark, Lucius V.
Deatherage, James M.
*Latvala, Woodrow J.
Long, W. W.
No Data Supplied
*Anderson, Eugene Carter
Houston, James A.
*Walter, Adolph S.

TYRONE

Phelps-Dodge Corp.
Finton, M. H.
Sudler, John M.
No Data Supplied
Shelton, Thomas L.

VANADIUM

Strong & Harris Inc.
Strong, Earl
White Sands Proving Grounds
Mantz, James C.
No Data Supplied
Cudney, G. E.

NEW YORK

AKRON

No Data Supplied
Shanley, James H.

ALBANY

N.Y. State D. P. W.
*Maxwell, Henry W.

N. Y. S. Geol. Surv.
*Broughton, John G.
U.S. Bureau of Mines
Graham, Hugh D.

ALFRED

State Univ. of N.Y. College of
Ceramics
*Brownell, Wayne E.

AMAWALK

Sherwin F. Kelly Geophys. Ser.
Inc.
*Kelly, Sherwin F.

AMSTERDAM

No Data Supplied
Zwolak, John

ARDSLEY ON HUDSON

No Data Supplied
*Warriner, Lendall P.

BABYLON

N.Y. State Dept. of Public
Works
*Rose, Newton
No Data Supplied
Ehrsam, Walter F.

BALMAT

St. Joseph Lead Co.
Dill, David B., Jr.
Henry, Ralph L.
Jones, M. C.
LaPrairie, Jules P.
*Lowry, Malcolm V.
Reilly, John G., Jr.
Riley, Mark E.
Wade, D. M., Jr.

BELLMORE

No Data Supplied
Bulin, George V., Jr.

BENSON MINES

Jones & Laughlin Steel Corp.
*Vickers, Wm. A.

BRONX

No Data Supplied
Novotny, Robert T.
Wax, Aaron M.

BRONXVILLE

No Data Supplied
*Klugescheid, Richard C.
Lundy, W. T.
West, John M.

BROOKLYN

Brooklyn College
Shimer, John A.
National Lead Co.
*Orsino, Joseph A.
Reed, George G., Jr.
No Data Supplied
*Churgin, James
*De U. Echebarria, Luis
Fischer, Jerome D.
Fox, John H.
Graveson, David H., Jr.
Jablom, Irving
*Nagel, Theodore
Osborn, Harry H.

BUFFALO

Derrick Mfg. Co.
Derrick, H. W., Jr.
Gen. Refractories Co.
Morlock, Harry A.
Hewitt-Robbins Inc.
*Hickey, Merrill H.
*Rivette, Gerarde, B.
National Gypsum Co.
Campbell, C. O.
*Pinto, Joseph, Jr.
*Sturgess, R. H.

CAIRO

No Data Supplied
Vendon, Mark A.

CALEDONIA

The Ruberoid Co.
Stewart, John K.

CANTON

St. Lawrence Univ.
*Brown, Severn P.
Elbert, W. T., Jr.

CORNING

Corning Glass Works
Klein, Martin, Jr.

DOUGLASTON

No Data Supplied
*Thompson, Lester S.

EAST MORICHES

No Data Supplied
Sample, Mat

EDWARDS

St. Joseph Lead Co.
De Clue, B. F., Jr.

ELMHURST

No Data Supplied
Brownstein, Leonard
Gross, Gerard W.
Nouza, Roger

FLUSHING

No Data Supplied
Bertram, John C.
Brinker, Arthur C.
Childs, Kenneth P.
Geffken, John
Guney, Mehmet

FOREST HILLS

No Data Supplied
Hall, Robt. D.
Weiss, Monroe L.
Ullmann, Thaddeus S.

GENEVA

Geneva Times
Williams, George B.
National U.S. Radiator Corp.
*Hanks, George R.
No Data Supplied
Bruner, Foster W.

GLENCOVE

Wah Chang Corp.
*Cole, James W.
No Data Supplied
*Belt, Charles Banks, Jr.
Cook, W. Lorrain

GOUVERNEUR

Gouverneur Talk Co., Inc.
Adams, Howard W.
Erdman, George E.
McClellan, Robert S.
Intl. Talk Co., Inc.
*Crawford, David J.
Dievendorf, Charles F.
*Kuehl, Frederick G.

HARTSDALE

No Data Supplied
Merrill, P. C.

HAVERSTRAW

N.Y. Trap Rock Corp.
Mead, Robert Elting

HEMPSTEAD

Hofstra College
Revel, Humbert S.

HICKSVILLE

G. W. Lauman & Co., Inc.
*Krietman, Abe

HORSEHEADS

No Data Supplied
Weigland, Glenn R.

HUDSON

U.S. Steel Corp.-U.A. Div.
*Mayne, Richard D.

ITHACA

Cornell Univ.
*Anderson, Alfred L.
*Gregg, James L.

JACKSON HEIGHTS

No Data Supplied
Ailars, Carl M.
Daniec, Stefan J.
Frouz, C. Y.

JAMAICA

Jamaica Test Boring Inc.
*Fishbein, Herbert J.

JAMESTOWN

Weaver Matl. Service
*Weaver, Don S.
Weaver, Fred L.

KATONAH

No Data Supplied
Davis, Donald W.

KEESEVILLE

Northern Minerals Inc.
*Burnham, Koert D.

KEW GARDENS

No Data Supplied
Steinberg, A. L.

LARCHMONT

No Data Supplied
Benno, Elkan

LATHAM

No Data Supplied
Rohrenbach, Don A.

LEWISTON

No Data Supplied
Erasmus, H. De Wet
Lentz, Kendrick W.

LITTLE NECK

No Data Supplied
Wolf, Harry J.

LOCKPORT

No Data Supplied
Potts, Allen Dewey

LONG BEACH

No Data Supplied
Lekowski, C. Steven
Sutz, Richard K.

L. I. CITY

No Data Supplied
Dodge, Basilios
Phin, Robert P.

LYNBROOK

No Data Supplied
Hubbell, A. H.

LYON MOUNTAIN

Republic Steel Corp.
Crusberg, Walter G.
Knox, Edwin R., Jr.

MINEOLA

Ducon Co.
*Lehern, Robert J.

MINEVILLE

Republic Steel Corp.
Blomstran, Wm. A.
Farrell, Patrick F.

MONTROSE

Blocked Iron Corp.
Imperato, L. George

MORICHES

No Data Supplied.
*Foot, F. W.

MT. VERNON

No Data Supplied
Shafer, Maurice

NATURAL BRIDGE

Carbola Chem. Co.
Beggs, F. L.

NEW CITY

No Data Supplied
Bode, C. F.
Siepits, Justin F.

NEW HAMBURG

N. Y. Trap Rock
*Kienitz, L. E.

NEW ROCHELLE

No Data Supplied
Ayer, Charles F.
Sargent, Robert E.

NEWTON FALLS

Newton Falls Paper Mill Inc.
Ross, A. M.

NEW YORK CITY

Adams & Peck
*LeMaire, Edward
A. G. I. Translation Center
*Faiz, Salih
The Allen-Sherman-Hoff Pump
Co.
*Jensen, Robert M.
Allied Chem. Corp.
Boggs, Wm. E.
*Dickson, Robert H.
Foust, John H.
Puttuck, Harry E.
Schmidt, Lawrence D.
*Sullivan, Edward G.
Trepp, Wilbert J.
Allis Chalmers Mfg. Co.
Cox, Irving K.
Erickson, Henry W.
American Brake Shoe Co.
Terbell, Joseph B.
American Cyanamid Co.
Behre, Merrill C.
Blocher, F. Wm., Jr.
Caldwell, A. Blake, Jr.
Collings, Barton M.
Featherstone, George J.
Frith, Charles W.
Gieseke, E. W.
Griffin, Frank A.
*Wintringham, Neil A.
American Embassy
Corry, Andrew V.
Goudarz, Gus H.
A.I.M.E.
Beals, Rixford A.
Fox, John Cameron
Kirkendall, Ernest
Tone, Donald R.
American Metal Climax Inc.
Aall, Christian H.
Ackerman, David H.
Bunker, Arthur H.
Chandler, John W.
Curzon, John J.
Deitz, Louis S., Jr.
De Neufville, Hugo
Ensign, Chester O., Jr.
Hochschild, Harold K.
Hochschild, Walter
James, Jack A.
Lambly, Chas. A. B.
Langley, Edward J.
MacLachlan, J. G., Jr.
Rose, Ernest T.
Stewart, Fred H.
Thomas, Weston G.
*Towle, Charles C.
American Metal Market
Lutjen, George P.
American Mus. Nat. History
*Pitschi, Arthur T.
American Re-Insurance Co.
Bayler, George E.
Amer. Smelt. & Refin. Co.
Anzalone, S. A.
Brown, Adin A.
Conley, Wm. Albert
Hart, Lyman H.
Jourdan, Ralph L.
Lord, John F.
Mann, Victor I.
Nelson, C. E.
Pearce, John G.
Pollock, C. P.
Pope, Darwin J.
Straus, Oscar S.
Strauss, Simon D.
Vaughan, R. Worth
Wolfe, A. Royce
Andacollo Min. Ltd.
*Strouth, Howard Steven
The Anaconda Co.
Brinkerhoff, C. M.
Campbell, T. A.
*Coulam, John R.
Dugan, John F.
Dwyer, Robert E.
Greeninger, Ira L.
Hoffman, John M.
Koepel, N. F.
Laird, Frederick
McGlone, Edward S.
Nelson, David R.
Newlin, Richard S.
Norton, John E.
Parkinson, C. Jay
Perry, Vincent D.
Quigley, William E.
Rood, Alfred D.
Schneider, Ralph E.
Weed, Clyde E.
Wraith, Wm., Jr.

Anaconda-Jurden Assoc. Inc.
Birkin, Dimitri
Boschen, Herman H.
Carpenter, Stewart
Holtz, Theodore H.
Manning, John Pearce, Jr.
O'Rourke, John T.
Raffo, Edward F.
Anaconda Aluminum Co.
Lewis Mord
Anaconda Wire and Cable Co.
Peck, C. B., Jr.
Geo. S. Armstrong & Co. Inc.
*Armstrong, George S.
Asea Electric Inc.
Zetterberg, Stig
Assoc. Metals & Min. Corp.
Schweitzer, H. C.
Baker Week & Co.
Fiske, Rodney G.
Barston, Muligan & Vallmer
Antonova, Helen A.
G. M. Bedford Co.
Wensley, Roger L.
Bear Creek Mining Co.
Kisvarsanyi, Geza
Behre Dolbear & Co.
*Banfield, Armine F.
*Clarke, Vinton H.
*Counselman, Theodore B.
*Dolbear, Samuel H.
*Donald, Douglas D.
Hodges, Parke Abernethy
*Madison, Frank H.
Moore, Elwood S.
Berwind-White Coal Min. Co.
Roberts, Newell W.
Harry S. Blumberg
*Blumberg, Harry S.
Bowring & Co.
Bowring, C. W., III
Brown & Root Inc.
Moreno, D.
Richard J. Buck & Co.
Olmstead, Joseph N.
Bucyrus-Eire Co.
*Norton, J. V. S.
Buell Engrg. Co.
Norvig, Otto V.
Pascual, S. J.
Vandenboeck, J. Paul
W. E. Burnet & Co.
Grover, E. L.
Calif. Texas Oil Corp.
Butterworth, E. M.
Callahan Min. Corp.
Hall, Joseph T.
*Wilson, Philip D.
Calumet & Hecla Cons. Copper
Lynch, W. W.
Central West Coal Co.
Brunjes, Henry L.
Cerro de Pasco Corp.
Chico, Raymundo J.
Ewoldt, Harold B.
Fischer, Francois A.
Keith, Stanton B.
Kellogg, John L.
Koenig, Robert P.
Littlefield, M. B.
McGowan, Joseph F.
Merz, A. Russell
Reynolds, Robert R.
Russell, Dalton L.
Russell, Frank F.
Spencer, Frank N., Jr.
Starr, H. Danforth
Strong, Earle A.
Vose, Gardner W.
Wood, William G.
The Chase Manhattan Bank
Kruzer, George E.
Chatham Chem. Corp.
Shea, Vincent H.
Chem. Const. Corp.
Jones, Wm. F.
Chicago Pneumatic Tool Co.
Doner, George B.
Walker, Leroy J.
Chile-American Assn. Inc.
Schert, Percy A.
Cie Aramayo de Mines en
Bolivia
*Kemper, Claude L.
The City College of N.Y.
*O'Connell, Daniel T.
City of N. Y.
*Stranberg, Morton
Greenwald, Morris
*Meyers, Bernard M.
Climax Molybdenum Co.
Haley, Dennis F.
Coal Age
Given, Ivan A.
Colombian Dev. Corp.
*Riley, John Alan
Colo. Fuel & Iron Corp.
Alter, M. L.
Bourne, Robert F.
Columbia Univ.
Arbiter, Nathaniel
*Behre, Chas. H., Jr.
Berman, Byrd L.
*Boshkov, Stefan
Bryers, Wesley E.
*Hassialia, M. D.

New York-New York

New York-New York

- *Holmes, Ralph J.
- Kerr, Paul F.
- *Sheinkin, Moshe
- *Taggart, Arthur F.
- *Wane, Malcolm
- Combustion Engrg. Inc.
- *Ellis, Robert S.
- Miller, Carl E.
- Continental Ins. Co.
- Heinbecker, Edw. G.
- Corey, Baxter & Kennedy Inc.
- Goddard, Paul
- Coronado Corp.
- *Lieb, Solomon S.
- Crucible Steel Co.
- *Persons, R. W.
- Cyanamid International
- Cadwell, E. P.
- Falconer, Stuart A.
- Denver Equip. Co.
- Beardsley, C. T. E.
- Diamond Tal. Res. Co. Inc.
- Gold, Joseph
- Dorr Assoc.
- *Baker, John A.
- EBASCO Services Inc.
- *Eastman, C. A.
- Friend, Walter F.
- A. G. Edwards & Sons
- Stott, Gordon D.
- Eimco Corp.
- Edwards, Theo A.
- Weems, Frank T.
- Engineered Materials
- *Gitter, A. J.
- Engineers Joint Council
- Lange, Esworthy P.
- Engrg. Index Inc.
- *Alexandrov, Eugene A.
- Engrg. Manpower Comm.
- Wheelock, Leroy K.
- Engrg. & Min. Journal
- *Antonides, Lloyd E.
- Elgo, D. P.
- Franklin, James W.
- Knoer, Alvin W.
- Ethyl Corp.
- Anderson, E. H.
- The First Nat'l. City Bank of N.Y.
- *Creamer, Thomas F.
- Fleischman, Burd & Co. Inc.
- *Fleischman, Herbert
- *Fawel, George W.
- Fordham Univ.
- Lynch, S. J. Rev., J. J.
- Ford, Bacon & Davis Inc.
- *Raymond, Louis C.
- Strongin, Oscar
- Fortune Magazine
- Solow, Herbert
- Freeport Sulphur Co.
- Bowenkamp, John E.
- Hills, Robert C.
- Main, Orrin H.
- Pierson, Henry L.
- Thaete, Edward H., Jr.
- Wilson, Forbes
- General Electric Co.
- Mead, George G., Jr.
- Geol. Soc. of America
- Aldrich, Henry R.
- The Gold Fields American Dev. Co. Ltd.
- Allen, Victor C.
- Bongard, Victor
- Lindberg, Carl O.
- Playter, Robert F.
- M. Goldetz & Co.
- Reese, Lemuel V.
- W. R. Grace & Co.
- Becker-Fluegel, H. A.
- Hook, William D.
- Kantorowicz, Rolf F.
- *Thomas, Josiah
- Guaranty Trust Co. of N.Y.
- Katransky, Joseph
- Gulf Oil Corp.
- *Hohmann, Harry E.
- Hardinge Co. Inc.
- Wittington, Wm. H.
- Harmon Lichtenstein & Co.
- Harmon, Robert B.
- Philip J. Healey Inc.
- *Healey, Philip Edward
- Hercules Powder Co.
- Pritchard, R. W.
- Sibley, A. H.
- Hewitt-Robins Inc.
- *Vander Laan, Martin
- Howard Int. Inc.
- *Cody, Thomas M.
- Howe Sound Co.
- McGonigle, F. A.
- Seward, George C.
- Weaver, William M., Jr.
- Hudson Bay Min. & Sm. Co. Ltd.
- Green, Waldron A.
- Hydrometals Inc.
- Hayden, William M.
- Import Export Ind.
- Finel, Raymond F.
- Ingersoll Rand Co.
- Adamson, Robt. W.
- Barnett, Milton J.
- Conkey, Henry G.
- Culbertson, Francis D.
- *Dickenson, Ernest H.
- Doubleday, G. C.
- Dye, James A.
- Hayes, Robert E.
- Keenan, Alan F.
- MacFarland, Roy G.
- McCormack, Max L.
- Olund, Robert L.
- Pinkerton, D. L.
- Piper, Derrill D.
- Richards, William G.
- Wiend, Joseph A.
- William, Edwin S.
- Inspiration Cons. Copper Co.
- Jacob, H. Myles
- Int'l. Minerals & Metals Corp.
- Cassara, Louis A.
- Gervais, Arthur J.
- Model, Wm. F.
- Int'l. Nickel Co. Inc.
- Davis, George H.
- Fraser, O. B. J.
- Lee, Gerald L.
- Monell, Theodore
- Gordon, J. Roy
- Spar, William H.
- Weldon, Joseph M.
- Wingate, Henry S.
- Int'l. Ore & Fertilizer Corp.
- Ten Eyck, H. S.
- Int'l. Selling Corp.
- De Vitry, R.
- Johns Manville Corp.
- Jessen, Heinrich C.
- A. Johnson & Co. Inc.
- Johnson, Axel Axsson
- Johnstown Coal & Coke Co.
- *Crichton, G. T.
- Joy Mfg. Co.
- Archibald, Donald L.
- *Bywalezt, Alfred
- Evans, Joseph G.
- Fritz, Glenn H.
- Lane, B. P.
- Miller, C. W.
- Williams, Philip M.
- M. W. Kellogg Co.
- *Swart, J. A.
- Kennecott Copper Corp.
- Atkinson, John Robert
- Boyd, James
- *Brackin, Robert B.
- Butler, Leonard F.
- Feist, Julian W.
- Frishie, Bryan R.
- Jesup, Paul B.
- Milliken, Frank R.
- Moon, Lowell B.
- Muse, Rush
- Russell, Gordon B.
- Shilling, J. D.
- Snapp, John B.
- Towley, Fred E.
- Woods-Smith, T. A.
- Kennedy-Van Saun Mfg. & Engrg. Corp.
- *Herschelman, E. C.
- Reedy, Richard W.
- Alan Kiscock & Co.
- *Kiscock, Alan
- Cyrus J. Lawrence & Sons
- Dudley, James C.
- Lazard Freres & Co.
- Forsch, Frederick D.
- Lead Ind. Assn.
- Ziegfeld, Robert Lindley
- Leggett, Brashears & Graham
- Graham, Jack B.
- *Stevens, Sam S., Jr.
- Lehman Bros.
- Lindley, A. H., Jr.
- Schultz, Harry Cameron
- Lentex Metal & Chem. Corp.
- *Leytes, Eugene
- Link Belt Co.
- Ulrich, G. H., Jr.
- Lone Star Cement Corp.
- Van Zandt, C. C.
- E. J. Longyear Co.
- *Merritt, Phillip L.
- Lybrand, Ross Bros. & Montgomery
- Leighton, John
- MacLean-Grove & Co. Inc.
- MacLenn, M. L.
- Malcolm Pirnie Engrs.
- Pirnie, Malcolm
- McCrossin & Co.
- *McCrossin, Edw. F.
- McGraw-Hill Pub. Co.
- *Chellson, Harry C.
- Coash, Carl J.
- McNeal, William H.
- Mercantile Metal & Ore Corp.
- Plana, L. D.
- Merrill, Lynch, Pierce, Fenner & Smith Inc.
- Forrester, Wm. A., Jr.
- Mentch, Robert L.
- Mesabi Iron Co.
- Hoffman, Arnold
- Metal Traders Inc.
- Friedlander, Kurt A.
- Miami Copper Co.
- Ffolliott, J. H.
- Arnold H. Miller Inc.
- *Miller, Arnold H.
- Minerac Corp.
- Fischer, Arthur H.
- Min. & Ind. Dev. Co. Inc.
- Dupret, Louis E.
- Mining & Industrial Equipment Co.
- *Bonardi, Jack P.
- Mining World Magazine
- Roberts, A. E., Jr.
- Molybdenum Corp. of America
- *Bailey, Harold D.
- Montgomery, Scott & Co.
- Eddins, George E.
- Moran, Proctor, Muesser & Rutledge Consult. Engrs.
- *Newman, Walter S.
- Morrison-Knudsen Co. Inc.
- *Phinney, E. Donald
- Wm. H. Muller & Co. Inc.
- Forbes, Jasmin M.
- Perkins, Enoch
- Natl. Assoc. of Mfgs.
- *Cannon, Daniel W.
- Natl. Carbon Co.
- Pitt, Wm. G.
- National Lead Co.
- Holland, John S.
- Holmes, W. Church
- Martino, Joseph A.
- Mayer, Andrew
- Reid, Joseph H.
- Reiser, A. R.
- Stranad, Joseph
- Wiles, Gloyd M.
- *Wunder, George W.
- National Zinc Co. Inc.
- Jeffrey, Frederick R.
- Hugo Neu Corp.
- Neu, Hugo
- Newmont Explor. Ltd.
- Sheldon, Robert F.
- Newmont Min. Corp.
- Banghart, M. D.
- Fulton, Robert B.
- Grunow, John E. D.
- Malozemoff, P.
- Mann, J. R. C.
- McQuiston, F. W., Jr.
- Richards, William F., Jr.
- Scheck, Friedrich A.
- Schmidt, Walter P.
- Searls, Carroll
- Searls, Fred, Jr.
- Searls, Robert J.
- Smith, William T.
- Tucker, Eugene H.
- Volkman, Henry W.
- New Jersey Zinc Co.
- Flinn, A. B.
- Forsyth, William T.
- Goodwin, Sidney S.
- Johnson, Lindsay F.
- Kenly, Robert G.
- McCann, R. L.
- Peirce, W. M.
- Pettijohn, W. T.
- N.Y. & Honduras Rosario Min. Co.
- *Altshuler, H. I.
- Anderson, Homer S.
- Reininger, Robert M.
- N.Y. Univ.
- *Chisholm, David B.
- *Tilson, Seymour
- Nordberg Mfg. Co.
- *Dow, Herbert W., Jr.
- North American Cement Corp.
- Hedley, Paul
- Northeastern Coal Bureau
- *McCarthy, Edmund
- Northfield Mines Inc.
- Lindley, Thayer
- O'Donnell & Schmidt
- *O'Donnell, Neil A.
- *Schmidt, William C.
- Olin Matheson Chem. Corp.
- Bennett, Malcolm G.
- Zilbersher, William M.
- The Ore & Chem. Corp.
- ayard, Paul C.
- Schreiber, Fred
- Schuetz, G. W.
- Pacific Tin Consol. Corp.
- Pate, Paul S.
- Miller, F. Stuart
- Paine, Webber, Jackson & Curtis
- Bailey, Carroll C.
- Panaminas Inc.
- Stranahan, Daniel M.
- Patino Mines & Enterprises
- Fajardo, R. Eduardo
- Pennie Edmonds Morton Barrows & Taylor
- Laist, James W.
- Penn. Glass Sand Corp.
- Reynolds, George I., Jr.
- Phelps Dodge Corp.
- Cates, Louis S.
- Dodge, Cleveland E.
- Hawkins, J. Muir
- Hope, John
- Lee, P. G.
- Masten, John E.
- Munroe, George B.
- Page, Robert G.
- Rea, J. C.
- Stuart, Herbert Z.
- Winship, Charles H., Jr.
- Pittston Co.
- Montgomery, C. R.
- Pogson Peloubet & Co.
- *Peloubet, Maurice E.
- Ramseyer & Miller
- *Kienzie, Fred
- Raybestos-Manhattan
- Chilcote, J. P.
- Revere Copper & Brass Inc.
- Collins, John J.
- Roger Smith Hotels Corp.
- de Lima, Oscar A.
- St. Joseph Lead Co.
- Brigden, George I.
- Cameron, Francis
- Chapin, C. Merrill
- Colvin, James G.
- Donald, Norman H., Jr.
- Fletcher, Andrew
- Isabel, W. T.
- Mechin, R. J.
- Ramsey, Robert H.
- Riggs, Lawrance, III
- Wormser, Felix Edgar
- St. Lawrence Corp.
- Poynter, Donald A.
- Samincorp S. A. Min. & Merchandise Corp.
- Rochschild, Mauricio
- Frank Samuel & Co. Inc.
- *Banks, Harold F.
- M. A. Schapiro & Co. Inc.
- Schapiro, Morris A.
- Scientific Design
- *Sternfels, Ernest A.
- Scudder, Stevens & Clark
- *Eakland, Edward H., Jr.
- *Quint, George
- Separations Engrg. Corp.
- Jarman, G. Wallace
- Shattuck Denn Min. Corp.
- Appell, Carl W.
- Lamond, N. E.
- Pierce, Jack C.
- Shelter Rock Dev. Corp.
- Baragwanath, J. G.
- Singmaster & Breyer
- Brunner, John J.
- *Chelminski, Roman
- *Reitke, M. K. T.
- *Russell, John C.
- Singmaster, J. A.
- Skidmore, Owings & Merrill
- Smith, John
- F. L. Smith & Co.
- Andersen, Axel Brix
- Deleuran, Henry
- *Petersen, Louis
- Thyvre, S. G.
- Harry W. Smith Inc.
- Hedges, Robt. W.
- So. American Gold & Plat. Co.
- Breeding, W. H.
- O'Neill, Patrick H.
- Shaffer, Robert E.
- Southern Peru Copper Corp.
- Goodwin, R. F.
- Spencer Trask & Co.
- *Campbell, Robert, Jr.
- Spencer White & Prentiss Inc.
- Prentiss, Edmund Astley
- C. H. Sprague & Son Co.
- Snyder, DeWitt C.
- Stein Hall & Co. Inc.
- Levine, Nathan M.
- Stricker & Henning Res. Assoc.
- *Stricker, Adam K., Jr.
- Stornkoppberg Corp.
- Dornajo, T. Olof
- Tata Inc.
- Warren, Edwin T.
- Tech. Equip. Corp.
- *Jacobson, M.
- Tekera Intl. Inc.
- *Lambur, Charles H.
- C. Tennant Sons & Co.
- Cutler, Ralph H., Jr.
- Halton, H. W.
- McIntosh, Frederick R.
- Tenn. Corp.
- Westlake, Emory H.
- The Texas Co.
- *Baker, Raymond F.
- Texas Gulf Sulphur Co.
- Aldridge, Walter H.
- Donohoo, H. V. W.
- Duecker, Werner W.
- Eddy, Emerson W.
- Fogarty, Charles F.
- Meagher, Edward C.
- Mollison, R. D.
- Nelson, Fred M.
- Tippie, Frank E.
- *Wright, Hugh
- Tippetts-Abbett, McCarty-Stratton
- *Marty, Edgar O.
- Tompkins Min. Mach. Corp.
- Tompkins, E. S.
- Tower & Bowers
- *Tower, George W.
- Amos Treat & Co., Inc.
- Greene, Charles T.
- Tungsten Min. Corp.
- *Sweet, James R.
- Tuthill & Co., Inc.
- Tuthill, Marshall W.
- Unified Holdings Inc.
- Kenna, R. K.
- Union Carbide Corp.
- Fransche, Dean F.
- Kinzel, A. B.
- Mahoney, Robert M.
- Union Carbide Nuclear Co.
- *Cortelyou, Arthur P.
- Cromer, Sylvan
- Lundquist, A. O.
- Union Carbide Ore Co.
- Beal, Wilder
- Buller, Arthur E.
- Eyde, T. H.
- Mee, Virginia A.
- Meek, T. H.
- Nelson, Graham A.
- Nicholson, Hugh P.
- Fraser, R. V.
- Pullen, Leslie W.
- Rove, Olaf N.
- Shanklin, Fred L.
- Shoemaker, Robert S.
- Spedden, H. Rush
- Warde, Dr. John M.
- United Nations Organization
- Delaire, Pierre C.
- U. S. Geol. Survey
- Johnston, Robert F.
- U. S. Govt.
- Mittendorf, Clarence O.
- U. S. Metals Ref. Co.
- Betchart, Arthur F.
- U. S. Smelt. & Refin. & Min. Co.
- Jenkins, Warren J.
- U. S. Steel Corp.—UAC Div.
- Funderburg, Louis M.
- Horen, Arthur
- Kivert, J. A.
- Osler, Richard L.
- Rugen, Chester D.
- Tresouthick, S. W.
- U. S. Steel Export Co.
- Mackenzie, J. T., Jr.
- U. S. Treasury Dept.
- *Dobson, Chris G.
- Wojo, Conrad A.
- Vaca Oil Co. Inc.
- Stehle, Carl
- Vanadium Corp. of America
- Sterling, Robert
- Vetricaulco Co. America
- Horlick, Alex
- Vitro Corp. of America
- Hall, W. B.
- Hotchkiss, Eugene B.
- Vitro Engrg. Co.
- *Petrie, Henry J.
- Webster Mfg. Inc.
- Di Clement, Roland
- Western Knapp Engrg. Co.
- *Evans, Wm. Harry
- *Lassiter, Richard T.
- Western Machinery Co.
- *Cognwell, H. K.
- *Frohling, Edard S.
- Whitehead Bros. Co.
- Maddison, Robert J.
- Whittaker, Clark & Daniels Inc.
- Wallace, Roff W.
- A. R. Wiffley & Sons Inc.
- Bonardi, Bruce B.
- World Min. Consults.
- Bennett, Evan
- Yuba Consol. Ind. Inc.
- Canada, John B.
- No Data Supplied
- Acker, Richard C.
- *Atwater, R. M., Jr.
- Austin, Albert M.
- *Ayer, Frank A.
- Bancroft, Howland
- *Baumann, H. N.
- Bell, Gordon K.
- Bereznay, E. V.
- Bernard, Clinton
- Bliss, Lyman A.
- Brehner, Elliott J.
- Brassett, H. A.
- Caceres, Manuel C.
- Channing, R. H.
- Coleman, L. W. R., Jr.
- Cornell, Irwin H.
- *Cowan, William W.
- Craig, Colgate, Jr.
- Cronau, Egmont W.
- Crosby, Richard E.
- *Daume, Lloyd E.
- Easley, George A.
- Egbert, Robt. D. B.
- Ferber, Ronald

Fitzgerald, J. M.
Fitzgerald, Wm. B.
Freakes, A. W. T.
Gluck, Samuel E.
Godfrey, Garvin H.
Graham, Oliver B., Jr.
Grant, Lester E.
Grant, Wheadon M.
Guggenheim, Harry F.
Heiko, Bernard
Hilton, Gary G.
Hirschhorn, Jos. H.
Hoffman, Robert D.
Holloway, Edward
Hoover, Herbert
Hudson, Percy K.
Illyefalvi, P. S.
Jicha, Henry L., Jr.
Just, Evan
Kemmerer, M. S.
Kendall, Messmore
Kojan, Eugene
Lane, J. F.
Lawson, A. W.
Lipton, Louis J.
McGavock, C. B., Jr.
Melitzer, Samuel
Metcalfe, June M.
Middlebrook, John
Miller, W. B.
Miller, Mahlon
Moscato, Richard
Mowman, P. A.
Moulton, H. G.
Mozian, Zareh
Najarian, Greg
Norrie, Lanifer B.
Notman, Arthur
Ochs, Felix
Okun, David
Osborn, William H.
Perlwitz, Chas. O.
Pierce, S. S.
Prochazka, George A., Jr.
Radling, Lewis L.
Reeves, George E.
Rising, Albert E., Jr.
Robinson, Jesse M.
Rosenberg, R. A.
Schider, Rudolph
Schmidt, Bill W.
Schottler, George R.
Schuberth, Chris J.
Sharp, Ernest H.
Sheffield, John R.
Shoemaker, Clyde H.
Singstad, Ole
Smirnow, Leonid
Smith, H. DeWitt
Spence, Reginald
Spring, Stanley G.
Trafton, Burke O.
Travenone, F. J.
Turner, Scott
Vickers, Edward L.
Walt, Andrew
Weekes, Frederic R.
Wemple, Holland R.
West, J. Frank
Wheelock, C. W.
Wise, Alfred L.
Wysoy, Davidson Charton

NIAGARA FALLS

The Carborundum Co.
Masterman, Earl W.
Moran, Paul W. F. J.
Papacharalambous, Harry G.
Sturgis, Donald G.
Sulecki, John S.
Wolkodoff, V. E.
National Lead Co.
Jacobs, Charles W. F.
Olin Mathieson Chem. Corp.
Motock, Geo. Thomas
Pittsburgh Metallurgical Co. Inc.
Remmers, Walter E.
Strategic-Udy Process Inc.
Udy, Marvin J.
Udy, Murray C.
Union Carbide Metals Co.
Carpenter, R. D.
Decker, Howard W., Jr.
Hard, Dr. Robert A.
Offenhauer, Charles M.
Sanden, Robert T.
Union Carbide Ore Co.
Aplan, Frank F.
No Data Supplied
Doerr, Jonh F., Jr.

NORTH CREEK

Barton Mines Corp.
Barton, Chas. R., Jr.
Barton, H. Hudson
Vogel, Herman H.
No Data Supplied
Pearse, Hubert A.

NORTH TARRYTOWN

No Data Supplied
Pearse, Hubert A.

NORWOOD

No Data Supplied
Hellock, Carl E.

OAKFIELD

U. S. Gypsum Co.
Miller, George T.

OYSTER BAY

American Mines Inc.
Labounsky, Alex

PALISADES

Lamont Geological Observatory
Fedukowicz, Wacław S.
Van Der Hoeven, F. G.

PLANDOME

No Data Supplied
Feely, James L.
Zeckmausen, P. W.

PLEASANTVILLE

Foley Bros. Inc.
May, Clyde R.
Young, Daniel H.

PORT CHESTER

No Data Supplied
Matson, Rubin W.

PORT HENRY

No Data Supplied
Butterfield, Howard M.
Scott, Jack R.

RETSEF

Intl. Salt Co.
Bush, Lewis P.
Martin, Stanley
Truax, Chester N., Jr.
No Data Supplied
Goetz, Reuben G.

ROCHESTER

Syndicate Oil Corp.
Jackman, Herbert E.
Univ. of Rochester
Alling, Harold L.
No Data Supplied
Rising, Vernon K.

RYE

No Data Supplied
Park, John Furness,
Ulrich, C. T.
Van Naessens, E. J.

SARANAC LAKE

Saranac Lab.
Roberts, Malcolm L.

SAUGERTIES

No Data Supplied
Warfel, J. D.

SCARSDALE

Kenite Corp.
Frankenhoff, Charles A.
No Data Supplied
Garretson, Mrs. Mary W.
Kursell, H. A.

SCHENECTADY

Alco Products Inc.
Foley, Dennis D.
Cushing Stone Co.
Murphy, Jeremiah F.
General Electric Co.
Charles, Richard J.
Ketner, Robert D.
Moore, Robert B.
Natural Resources Locating Corp.
Merrill, Delbert J.
Union College
Hewitt, Philip C.

SOUTHAMPTON

No Data Supplied
Dolliver, Chas. M., Jr.

SOUTH NYACK

No Data Supplied
Kay, Fred D.

STAR LAKE

Jones & Laughlin Steel Corp.
Djuvik, Carl
Eastman, E. A.
Fleck, R. G.
Peterson, A. F., Jr.
Rowand, Howard C.
West, F. J.
No Data Supplied
Lund, L. H.
Taylor, H. J.
Wright, Kenneth H.

STATEN ISLAND

No Data Supplied
Hammer, Edward J.
Mundaca, Ciro T.
Tilson, Ann M.
Wellnitz, Anna M.

STONY BROOK

No Data Supplied
MacKenzie, Thos. A.

SYOSSET

Fairchild Camera & Instrument Corp.
Schorle, Herman J.

SYRACUSE

Syracuse Univ.
Chute, Newton E.
Coen, Richard F.
Newton, Robert S.
No Data Supplied
Geiser, K. W.

TAHAWUS

National Lead Co.
Bassarac, John H.
Begor, Charles R.
Chapman, Walter M.
Dellinger, Brower
Gross, Stanford O.
Hall, John G.
Hatch, Dexter C.
Kingman, Robert I.
Morris, Paul E.

TOMKINS CONE

N. Y. Trap Rock Corp.
Foeter, John C.

TONAWANDA

Super Soils Inc.
Bray, Joseph M.

TROY

Roland F. Beers Inc.
Beers, Roland F.
Remmler Polytech. Inst.
Dunn, James R.
No Data Supplied
McCarthy, Peter F.

TUXEDO

Union Carbide Nuclear Co.
Schlow, Donald H.
Woolery, Robert G.

UTICA

Chicago Pneumatic Tool Co.
Hallett, A. F., Jr.
Lear, E. B.
Eastern Rock Products Inc.
Owens, John V.
No Data Supplied
Tucker, Mana L.

VALLEY STREAM

No Data Supplied
Schatz, W. S.

WATKINS GLEN

Intl. Salt Co. Inc.
Wrighton, Richard W.

WEBSTER

No Data Supplied
Lauer, Frederick C.

WEST NYACK

N. Y. Trap Rock Corp.
Dow, Melvin C.
McDonough, Donald W.
Schwellenbach, Henry

WHITE PLAINS

No Data Supplied
Loghry, James D.

WILLISTON PARK

No Data Supplied
Williams, J. B., Jr.

WILLSBORO

Cabot Carbon Co.
Hall, Arthur L.

WOODMERE

Integrated Mica Corp.
Heyman, Moses D.

WOODSIDE

Columbia Technical Corp.
Ordjanian, Dr. Nikit, P. E.

YONKERS

No Data Supplied
George, Jack W.
Moyd, Louis
Moyd, Pauline

YORKTOWN HEIGHTS

No Data Supplied
Robie, Edward H.

NORTH CAROLINA

ASHE CITY

Seminole Rock & Sand Co.
Lasiter, Robert G.

ASHEVILLE

Southeastern Dia. Drilling Co.
Jennings, J. F., Jr.
N. C. State College
McDaniel, William T., Jr.
Peterson, Roy E.
No Data Supplied
Sharp, Harold H.

BELMONT

No Data Supplied
Corn, Russell M.

BESSEMER CITY

Lithium Corp. of Amer. Inc.
McClure, J. N.

BURNSVILLE

Hassett Mining Co.
Adair, Ralph B.

CHAPEL HILL

Univ. of N. C.
Michalek, Daniel D.

CHARLOTTE

Hewitt-Robins, Inc.
Brown, Gene
No Data Supplied
Laine, Robert B.

CLINTON

No Data Supplied
Hope, R. C.

DAVIDSON

No Data Supplied
Weichel, Edgar C.

DURHAM

Duke Univ.
Berry, Willard
Heron, S. Duncan, Jr.

FAYETTEVILLE

No Data Supplied
Coffman, Peyton R.

FT. BRAGG

No Data Supplied
Tilmon, Carl C.

GASTONIA

No Data Supplied
Robinson, Clyde H.

GOLDSBORO

No Data Supplied
Miller, Chester E.

New York-North Carolina

HENDERSON

Greystone Granite Quarries,
Hedrick, H. Dermont
Tungsten Mining Corp.
Atkins, William R.
Szykiewski, A. M.

HENDERSONVILLE

No Data Supplied
Wood, A. Hamilton

HICKORY

No Data Supplied
Daniel, Jay R.

JEFFERSON

Appalachian Sulphides
Nameth, Stephen J.

JEFFERSON

No Data Supplied
Eckman, M. A.

KINGS MOUNTAIN

Foot Mineral Co.
Albrecht, Theodore J.
Flow, Ralph C.
Goter, Edwin R.
Hall, Robert
Horst, William E.
Johnson, Neil O.
King Mountain Mica Co., Inc.
Lancaster, Paul A.
No Data Supplied
Kestler, Thomas L.

LINCOLNTON

Basic Atomic Inc.
Wingo, Robert W.
Lincoln Nat. Conc. Corp.
Clark, Walter

MURPHY

The Hitchcock Corp.
Bourne, Francis C.
No Data Supplied
Van Horn, Earl C.

NEWDALE

Deneen Mica Co.
Sherertz, Joe R.

RALEIGH

N. C. Dept. of Cons.
Stuckey, Jasper L.
N. C. State
Broadhurst, Sam D.
N. C. State College
Hammes, John V.
Miller, E. L., Jr.
Moffitt, Roy R.
Parker, John M., III
N. C. State Museum
Davis, Harry T.
U. S. Geol. Surv.
LeGrand, Harry E.
No Data Supplied
Gardner, Richard A.

ROANOKE RAPIDS

No Data Supplied
Knight, Kenneth M.

ROCKY MOUNT

No Data Supplied
Murchison, Roderick G.

SALISBURY

Soil Cons. Serv.
Ferrell, James C.

SHELBY

No Data Supplied
Mauney, Robert E.

SOUTHERN PINES

No Data Supplied
Butler, Howard N.

SPRUCE PINE

The Feldspar Corp.
McMurray, L. L.
No Data Supplied
Gibbs, C. M., Jr.

SYLVA

No Data Supplied
Gillis, Julius H.

North Carolina-Ohio

TUNGSTEN

Tungsten Mining Corp.
Hager, Phipps A.

WARRENTON

Haille Mines Inc.
Long, W. Lunsford

WILMINGTON

Atlantic Coast Line R. R.
Council, Richard J.
Llewellyn, Clement M., Jr.
No Data Supplied
LeGrand John R.

WINSTON SALEM

R. J. Reynolds Tobacco
Richmond, R. M.

NORTH DAKOTA

FARGO

No Data Supplied
Anders, F. L.

GRAND FORKS

Univ. of North Dakota
*Cooley, Albert M.
Erickson, Peter W.
*Kohanowski, Nicholas N.
Koth, Arthur
U.S.G.S.
Eckhoff, O. B.
No Data Supplied
*Erickson, Roland I.
Owen, Wallace
Setterlund, R. B.
Short, Maynard P.

JAMESTOWN

No Data Supplied
Andersen, R. Douglas
Burr, Alex C.

PINGREE

No Data Supplied
Bell, Gordon L.

WILLISTON

Great Northern Railway Co.
Reed, Henry E., Jr.
No Data Supplied
Evitt, Russell D.

OHIO

ADENA

No Data Supplied
Garbesi, V. A.

AKRON

B. F. Goodrich
Traxler, E. R.
Robinson Clay Prod. Co.
Sutherland, J. C.
No Data Supplied
Chase, Paul W.

ALLIANCE

Babcock & Wilcox Co.
*Young, Robert C.

BARBERTON

Babcock & Wilcox Co.
Pearson, Leonard
Shewmon, Daniel C.
Wilcomson, L. S.
No Data Supplied
Manderfield, B.

BAY VILLAGE

No Data Supplied
Reinker, Norman W.

REDFORD

Borg-Warner Corp.
*Trollor, Theodor H.
Ferro Corp.
Fuchman, Charles H.
S. K. Wellman Co.
Wellman, S. K.

BEVERLY

Interlake Iron Corp.
St. Vincent, Frank

CADIZ

Hanna Coal Co.
*Connolly, Wm. P.
Hyslop, James
Bradford, Thomas P.
*Gibson, O. Clyde
Reilly, James
Schneider, Geo. G.

CAMBRIDGE

Vanadium Corp. of Amer.
Arcoleo, Thomas F.
*Kuhn, Robert S.
Rasmussen, Robert T. C.
Rathmann, H. W.
Roman, Byron S.

CANFIELD

Amer. Fire Clay & Prod. Co.
Day, Britton T.

CANTON

Amer. Mine Door Co.
Gurney, Glenn D.

CELINA

No Data Supplied
Short, Tom

CHESHIRE

Ohio River Collieries Co.
Gentile, Tony

CHILLICOTHE

Basic Construction Mtl.
Neikirk, Charles W.

CINCINNATI

Appalachian Coals Inc.
Tobey, Julian E.
Chem. & Ind'l. Corp.
O'Hara, B. M.
Consolidated Coal Co.
Clayton, Carl W.
Continental Min. Proc. Corp.
Hauck, Frederick A.
Highway Ept. Co.
Russell, Thomas F.
Ingensoll Rand Co.
Cooper, Sidney D.
Jewell Ridge Coal Sales Co.
Inc.
Robertson, Alex E.
Logan & Kanawha Coal Co.
Inc.
*Fields, John R.
National Distillers & Chem.
Corp.
Foos, Raymond A.
Nat. Lead Co. of Ohio
Mead, Joseph Charles
Scott Nat'l. Handling Co.
Harvey, Alfred S.
Chas. Taylor Sons Co.
Maupin, Addison
Traux-Traser Coal Sales Co.
Nichols, Walter B.
Patton, Maynard L.
No Data Supplied
Stilwell, S.

CLEVELAND

Amer. Iron Ore Assoc.
Johnson, Hugo E.
Basic Inc.
Casey, John A.
Ellis, Howard P., Jr.
Muller, Max
Pearson, Edward P.
Shurtz, Robert F.
Allis Chalmers Mfg. Co.
Stewart, A. L.
Chesapeake & Ohio Railway
Davis, Ira F.
Foy, C. Benjamin
Hoesler, Edward W.
Cleveland Cliffs Iron Co.
Hollister, J. B., Jr.
*Sterling, Walter A.
Taber, Robert W.
Cleveland Twist Drill Co.
Emmons, Joseph V.
Consolidation Coal Co.
Ireland, R. Livingston
Diamond Alkali Co.
Ankudinoff, N. G.
*Lefond, Stanley J.
*Richner, Donald R.
Welshans, L. T.
H. K. Ferguson Co.
*Heller, Edward L.
Louis Gulletta & Co. Inc.
Johnson, Richard L.
M. A. Hanna Co.
Anderson, Robert F.
Buford, J. W.
Chace, Frederic M.

Gustafson, J. K.
Hagen, John C.
*Harrison, Perry G.
Phillips, Peter M.
*Rieger, J. C.
Schellinger, A. K.
Smith, Calvert
Vedensky, D. N.
Walker, R. S.
Webber, Benj. N.
Whitney, R. W.
Harshaw Chemical Co.
Hay, John O.
Pine, Paul R.
Independent Explosive Co.
Weitz, John H.
Intrusion-Prepack Inc.
*King, John C.
Lincoln Elect. Co.
Morris, J. Howard
Todd, Arthur W.
Lorain Coal & Dock Co.
Williams, Lloyd
McDowell Co.
Ban, Thomas E.
Doversberger, V. C.
McDowell, Robert C.
*Rowen, Allen R.
Rowen, Harold E.
Thompson, Charles D.
Arthur G. McKee & Co.
*Checkley, D. M.
*Cox, Merrill
Greenwall, Richard B.
Mining Machine Parts Inc.
Bigler, W. Paul
M & O Coal Co.
Ray, Harmon C.
Natl. Malleable & Steel
Castings
Smith, Herbert H.
Woody, Fred C.
Yearley, B. C.
Natl. Steel Corp.
Humphrey, George M.
No. Amer. Coal Corp.
Morris, Robert N.
Sullivan, David Lee
Oglebay Norton Co.
Dadd, Melvin W.
*Petzer, Wallace G.
Hamilton, W. D.
*Martin, Henry K.
*Smith, Frank J.
Taylor, Harrie S.
Ohio Dept. of Highways
Friedman, Lawrence
Pickands Mather & Co.
Arms, Charles S.
Carey, Robert S.
Ford, Allen H.
Hassett, J. S.
Jackson, Herbert C.
Mapes, E. J., Jr.
Sponberg, Edwin C.
Reliance Elect. & Engr. Co.
Jenkins, James M.
Republic Steel Corp.
Allen, George W.
Babcock, Donald E.
Dewey, Charles H.
Eggleston, Edward R.
Hazel, John J.
Klumb, Ronald G.
Kuperus, Cornelia
Liggett, Robert P.
*Miller, S. A.
Reed, William A.
Seaforth Min. & Ore Co.
McClurg, J.
Sylvester & Co.
Technical Services Inc.
*Craig, John J.
Gramp, Otto G.
Textor Labs Inc.
Textor, Ralph B.
W. S. Tyler Co.
Irwin, David McRae
Kaufman, V. A.
Kuenhold, Ned I.
Lawrence, Harry F.
Norlin, J. M.
Reed, Albert E.
Valley Camp Coal Co.
Ewig, Harry T.
Richey, Herbert S.
Wellman Engr.
*Ludwig, Carl
Westinghouse Air Brake Co.
Feucht, Jacob E.
Feucht, Albert
No Data Supplied
Andrews, J. V.
Cockrell, Edwin E.
Denison, R. Russell
English, Alan
Ferrer, Richard O.
Fitzhugh, Edw. F., Jr.
Weber, W. P.
*Wyman, Clifton L.

CLEVELAND HGTS.

No Data Supplied
Gunning, Samuel D.
Haven, Wm. A.
Meyer, Andrew

COLUMBUS

Amer. Blower Corp.
Tyson, James T.
Battelle Memorial Inst.
Anderson, Richard J.
Beale, Louis C., Jr.
Brisson, Robert J.
Carmichael, Ronald L.
Crout, John S.
Elizey, Vernon W.
Jacobs, Daniel A.
Langston, Benny
Lund, Richard J.
MacDonald, Robert D.
Minton, David C., Jr.
Richardson, A. C.
Russell, Howard W.
Schatz, Raymond W.
Shea, James F.
Smith, William Lee
Sullivan, John D.
Tangel, Oscar F.
Wesner, Adam L.
Bituminous Coal Research Inc.
du Breuil, Felix L.
*Garvey, James R.
*Grace, R. J.
Saltsman, Robert D.
Updegraff, Loy A.
Consolidation Coal Co.
Lee, Arthur L.
Davon Inc.
Pattin, Robert M.
A. H. Dierker & Assoc.
*Dierker, A. H.
Industrial Nucleonics Corp.
*Reider, James E.
Jeffrey Mfg. Co.
Bird, Byron M.
Flint, James A.
Fulford, J. H.
Hebden, Edward H.
Petersen, M. S.
*Schilbe, Carl G.
Wilson, J. E. M.
Michigan & Southern Coal
Corp.
*Gleaves, Clifton B.
*Stilwell, R. F.
National Elect. Coil Co.
Hatfield, D. Wendell
Kirby, Fred W. C.
*Price, Bailey E.
Ohio State Univ.
*Frantz, Robert L.
Lamey, Carl A.
Lucas, J. Richard
McCaughy, Wm. J.
Mueller, William A.
Tucker, LeRoy
Sunnyhill Coal Co.
Lamm, A. E.
U. S. Geolog. Survey
Rooske, Rodney H.
Schopf, James M.
Clyde Williams & Co.
*Williams, Clyde
No Data Supplied
Clemens, John I.
Durbin, W. P., Jr.
Nold, Harry E.
Reilly, G. A.
Root, G. Stephen
Warner, Max M.

CUYAHOGA FALLS

No Data Supplied
Nast, P. H.
Thornton, J. L.
Walter, A. B.

DAYTON

No Data Supplied
Loedding, Donald R.

DOVER

No Data Supplied
McCatty, Ken W.

EAST LIVERPOOL

Patterson Fdry. & Mach. Co.
Wright, J. E.

ELYRIA

Concrete Masonry Corp.
Goudvis, Theodore L.

FINDLAY

Differential Steel Car Co.
Hughes, Shelly G.
Flowers, H. Fort

FOSTORIA

Basic Inc.
Addis, Edwin M.
Hughey, Vaughn V.

FREMONT

No Data Supplied
Morris, Peter A.

GALENA

No Data Supplied
Smith, Frank G.

HILLSBORO

Davon Inc.
Bowman, Richard S.

JACKSON

No Data Supplied
Bailey, Arthur L.

JEFFERSON

No Data Supplied
Clifton, H. Edward

LAKEWOOD

No Data Supplied
*Johnston, Verne D.

LEETONIA

Thermocel Co.
Bertelsen, Robt. C.

LIMA

No Data Supplied
Bodell, William C.

LORAIN

U. S. Steel
Harlan, Fred E., Jr.

LOWELLVILLE

Carbon Limestone Co.
Chisholm, Robt. H.

MANSFIELD

Ohio Brass Co.
*Preston, Wm. C.
Sanford, J. H.

MARBLEHEAD

No Data Supplied
Almes, Marion C.

MARIETTA

Marietta College
*Freeland, Jean
Union Carbide Metals Corp.
Evans, Fred L.

MARION

Marion Power Shovel Co.
Busick, Adrien F., Jr.
Cornell, M. V.
Geller, Mike
Mosley, Lafayette C.

MEDINA

No Data Supplied
McCoach, Richard

MIDDLETOWN

Armco Steel Corp.
Enochs, David J.
Kingsbury, C. L.
Olt, T. F.

MINERVA

No Data Supplied
Bonta, Earl C.

NELSONVILLE

No Data Supplied
Ong, Philip H.

OLMSTED FALLS

Lee E. Ives Inc.
Ives, Lee E.

OXFORD

Miami University
*Thoms, John A.

PAINESVILLE

Diamond Alkali Co.
Brown, Burton
Morton Salt Co.
Ryland, Robert R.

ROSSFORD

No Data Supplied
Fletcher, E. K.

SAINT CLAIRSVILLE

BBR Drilling Co.
Balcar, Frank
Hanna Coal Co.
Beare, W. E.

SHAKER HEIGHTS

No Data Supplied
Hugus, C. E., Jr.
McAfee, Alexander
Miskell, Ford
Morgan, Milton F.
Parks, F. Newton
Prendergast, J.

SPRINGFIELD

Bauer Bros. Co.
*Wright, J. Howard

STUBENVILLE

McMasters, Kerr, & Wineman
*Jenks, E. H.

STRONGSVILLE

No Data Supplied
Warholyk, Charles A.

TOLEDO

Owens Illinois Glass Co.
Richards, Ray S.
U. S. Army
Abrams, Col. B. B.

TRENTON

No Data Supplied
Kuklis, Andrew

WELLINGTON

Wedge Wire Corp.
*Harper, Robt. J.
*Pearsall, Robert P., Jr.

WELLSTON

K. Frins and Assoc.
*Prins, Klaas

WELLSVILLE

H. K. Porter Co., Inc.
Mason, A. Perry

WESTERVILLE

No Data Supplied
Muston, Geo. H.
Wright Patterson AFB
U.S. Air Force
Benedict, Louis P.

YOUNGSTOWN

Buckeye Coal Co.
Grant, Alex
C.S. & S. Co.
*Siegrist, Ralph S.
Industrial Silica Corp.
*Forman, P. G.
Youngstown Sheet & Tube Co.
*Braden, O. S.
Bremner, Robt. P., Jr.
Dicks, Sheldon J.

ZANESVILLE

Ayers Mineral Co.
Sawyer, Edward C.
Central Ohio Coal Co.
Coulson, Frank
Central Silica Co.
Lincoln, R. V.
Columbia-So. Chem. Corp.
Farst, Walter K.
Petty, R. E.
No Data Supplied
Moore, Philip C.

OKLAHOMA

BARTLESVILLE

Phillips Petr. Co.
Hall, Merle L.
Holmes, Clifford N.
Walls, William S.
U.S. Air Force
Kravitz, Joseph H.
U.S. Bureau of Mines
Netzeband, F. F.
Sanford, Robert S.

CARDIN

Eagle-Picher Co.
Chadwick, Robert A.
Cuddeback, F. J.
Dale, Calude O.
Elizondo, Joseph B.
Wetherell, L. E.

ENID

No Data Supplied
Silver, Edward D.

HENRYETTA

Eagle-Picher Co.
Wade, John B.
No Data Supplied
Taylor, Gene

MC ALESTER

Lone Star Steel Co.
*Cameron, Campbell R.
Curry, Burrell L.
U.S. Geol. Surv.
Dinsmore, A. M.

MIAMI

The Eagle-Picher Co.
Brockie, Douglas C.
Rockwell, O. A.
U.S. Geol. Surv.
Bailey, Andrew V.
Gordon, Lawrence E.
No Data Supplied
Coulter, Don M.
Moran, Ernest
Wright, Hugh

MUSKOGEE

H.G.S. Anderson & Sons
*Anderson, H. G. S.

NORMAN

University of Okla.
Branson, Carl C.
*Ham, William E.

OKLAHOMA CITY

Kerr-McGee Oil Ind.
Barkley, Raymond C.
McGee, Dean A.
Sinclair Oil & Gas Co.
Smith, Frederick J.

PICHER

Buffalo Mining Co.
Childress, H. L.
Landis Steel Co.
Landis, Miles B.

PONCA CITY

Continental Oil Co.
Huffman, Joe D.

POTEAU

No Data Supplied
Orr, James F.

TULSA

Amerasia Petr. Corp.
Millikan, C. V.
Blackwell Oil & Gas Co.
Schultz, Paul R.
Gardner Denver Co.
Caldwell, Robt. G.
Dallas Deem, Manu.
Knopp, Roger
Kewanee Oil Co.
Parker, Norbert A.
Moab Uranium Co.
Hickman, C. M.
Pan Amer. Petr. Corp.
Friedman, Gerald M.
Penn Royalty Co.
Reynolds, K. W.
Seismograph Service Corp.
Baltosser, Robert W.
Bunker, John G.
Sinclair Oil Co.
Pelzer, H. L.
Pollard, Ward K.
U.S. Geol. Surv.
Johnson, Edward L.
No Data Supplied
*Bogle, Don E.
Faxon, Richard D.
Osborne, A. B.
Reed, James E.
Richards, Raymond

WOODWARD

No Data Supplied
Main, Paul A.

OREGON

ALBANY

U.S. Bureau of Mines
Banning, Lloyd H.
Brown, Lawrence L.
Gallagher, A. E. J.
Hess, H. D.
Kauffman, A. J. Jr.
No Data Supplied
Town, Joseph W.

ASTORIA

No Data Supplied
Alexis, Jos. H. V.

BAKER

Chemical Lime Co.
Thomas, Ned
State Dept. Geol. & Min. Ind.
Wagner, Norman S.
No Data Supplied
Anderson, H. Ferrel
Vervaeke, R. G.

CORVALLIS

Blue River Mines
Watkins, Kenneth O.
Oregon State College
*Allison, Ira S.
Caldwell, Wm. E.
*Carnahan, Gary L.
*Koch, George S., Jr.
*Wilkinson, W. D.
U.S. Air Force
Hartung, Ludwig F., Jr.
No Data Supplied
Gallagher, J. H.
Hampton, Eugene R.

COTTAGE GROVE

Lane Minerals, Inc.
Barton, Harold E. L.

CRESWELL

No Data Supplied
Napper, Jack E.

EUGENE

United Pacific Min. Corp.
*McLeod, Gordon B.
University of Oregon
*Hilker, Carl F., Jr.
*Staples, Lloyd W.
No Data Supplied
Bristow, Milton M.
Harlow, Jean S.

FOREST GROVE

Fremont Mining Co.
McKee, John P.
No Data Supplied
Blair, Frank H., Jr.
Leatherman, R.

GRANTS PASS

Oregon Dept. Geol. & Min.
Ind.
Peterson, N. V.
Ramp, Lenix
No Data Supplied
*Pressler, Jean W.
Robertson, Wm. S.

GRESHAM

No Data Supplied
Tauscher, Jos. E.

HILLSBORO

E. A. Messer & Assoc., Inc.
Messer, Ernest A.

JACKSONVILLE

No Data Supplied
Maddox, Terry

KLAMATH FALLS

U.S. Bureau of Reclamation
Renning, John A.

LAKEVIEW

Lakeview Mining Co.
*Haubold, Niels B.
Kutz, Kenneth J.
Poulos, James F.
Thornburg, Dr. Garth W.
No Data Supplied
Wein, Philip S.

MC MINNVILLE

No Data Supplied
Herring, John C.

MEDFORD

No Data Supplied
*Ingle, Hugh C.

PORTLAND

Bureau of Land Mgmt.
Hattan, Elton M.
Ocasar, Roger O.
Susie, Hall F.
Electric Steel Foundry Co.
Haney, C. E.
Williamson, R. G.
Wustrack, O. H.
Farnham Chem. Co.
Farnham, Willard
Gladding McBean & Co.
Whitney, Eugene H.
Ingersoll Rand Co.
Leary, John H.
Pacific Carbide & Alloys Co.
Waters, Thomas J.
Kenneth Poorman Co.
*Poorman, John M.
Oregon Dept. of Geol. & Min. Ind.
Dole, Hollis M.
Hoagland, L. L.
Mason, Ralph S.
Matthews, Thos. C.
Schlicker, Herbert G.
Portland State College
*Allen, John Elliot
Reynolds Metals Co.
Chapman, R. T.
Neathery, Thornton L.
U.S. Army
*Zwick, Walter H.
U.S. Bureau of Land Management
Berlin, Leonard M.
No Data Supplied
Anderson, J. R.
*Bartell, A. O.
Biro, Hobart M.
Bloch, Ivan
Dempster, R. C.
Fealy, Wm. A.
Friedie, F. J.
Gregory, Cecilia D.
*Hamblen, K. E.
Hanson, Richard L.
*Hines, Pierre R.
*Huseby, J. G.
Kershaw, Chet A.
*Libbey, Fay W.
McMurdo, Chas. E.
Orr, James M.
*Richards, Leslie C.
Shepard, S. Y., Jr.
Turner, William J.

RIDDLE

Hanna Nickel Smelting Co.
Hard, Herbert W.
Mollard, Earl S.
Rosser, L. E.

ROGUE RIVER

Bristol Silica Co.
Bristol, Fayette I.

SALEM

Lime Products Co.
Leonard, Theodore T.
Oregon State Government
*Gustafson, Fred D.
No Data Supplied
Fretwell, W. R.

SUMPTER

Buffalo Mine
Fern, Ed
Jackson, J. P., Jr.
No Data Supplied
Woodwell, Arthur H.

TIGARD

No Data Supplied
*Mears, Henry S.

TROUTDALE

Reynolds Metals Co.
Shoemaker, Henry W.

PENNSYLVANIA

ALLENTOWN

Allentown Portland Cement Co.
Douglass, A. E., Jr.
Myers, Philip B.
Lehigh Portland Cement Co.
Warkessel, Carl A.
Yost, Charles W.
Traylor Engrs. & Mfg. Co.
Eckmann, Henry A.
Moet, Arthur C., Jr.
Wittmer, B. Franklin

Ohio-Pennsylvania

Trojan Powder Co.
Finkley, Leonard A., Sr.
No Data Supplied
Burnell, Henry J.

ALTOONA

Gwin Engineers, Inc.
*Foreman, John W.

ANNVILLE

No Data Supplied
Williams, E. D., Jr.

ARDMORE

Maryland New River Coal Co.
Jordan, T. Gibson

ASHLAND

Laubenstein Mfg. Co.
Laubenstein, A. R.
Middleton, Harold R.
No Data Supplied
Gilroy, F. H.
Sellers, Geo. M.
Waskovich, M. J.

ASHLEY

Glen Alden Corp.
Chapin, Cyrus W.
*Jennings, Frederick W.
*Powell, E. T.
*Swartwood, George F.
Waslofski, Walter
Wickey, H. B.

ATLAS

No Data Supplied
Bridy, Edward A.

AVOCA

Heidelberg Coal Co.
McDade, John B.

BAINBRIDGE

Polishing Research & Control
de Vitry, Pierre

BALA-CYNWYD

Esso Standard Oil Co.
Reilly, C. Tyson

BARNESBORO

Barnes-Tucker Co.
Todhunter, John S.

BARNESVILLE

No Data Supplied
Petusky, Joseph

BATH

Keystone Portland Cement Co.
Maurer, Paul F.
Michaels, Harry J.

BEAVER FALLS

Rabeneck & Wilcox
Hamilton, Newell
No Data Supplied
Miller, John G.

BEDFORD

Kennametal, Inc.
*Carroll, Edward J.
*Johnson, Edwin H.
Saxman, Duane S.
*Turoski, Stanley
No Data Supplied
Shannon, Spencer S.

BELLEFONTE

Nat'l. Gypsum Co.
*Carlson, John L.
Warner Co.
Andre, Henry E.
Corre, H. A.
Smith, Robert Langland
No Data Supplied
Gustafson, Harold F.
Mallory, E. R.

BENTLEYVILLE

No Data Supplied
Conrad, Otis E.

BERWTN

Footo Mineral Co.
Coghlan, David B.
Lifton, Felix B.
Mao, George W.
Mitchell, David W.

Pennsylvania-Pennsylvania

BETHEL PARK

No Data Supplied
Mahan, W. M.
*Paulick, P. R.
Ruttie, Eugene T.

BETHLEHEM

Bethlehem Steel Co.
Adair, G. L.
Biemensderfer, George K.
Entrekina, Paul B.
Foster, J. C.
Fraser, Donald M.
Frith, D. L.
Gulder, James W.
Hitzert, Henry W., Jr.
Keiler, John A.
Lake, Simon, III
Leach, Edward P.
Limons, Robert A.
Lyons, D. S.
*Mahood, G. Phillips
Mancke, Edgar B.
McIlwain, Hugh T.
Nicholson, Bruce J.
Peterson, A. F.
Rankin, William A.
Starr, F. M.
Tebelman, C. G., Jr.
Telfair, Peter
Van Nuy, Francis
Ward, Stanley A.
Lehigh Coal & Navigation Co.
Dodson, John E.
Lehigh Navigation Dodson Co.
Frale, Foster F.
Lehigh University
*Brune, Arthur W.
*Gallagher, Robert T.
*Gault, H. Richard
*Horak, George C.
McCarthy, Frank J.
No Data Supplied
Branda, Richard R.
Cherks, John J.
Cumings, William S.
Dick, Charles J.
Fretz, A. H.
Geo, Kenneth H.
Hole, Gilbert L.
Howells, Lewis W., Jr.
Kaufman, A. T., Jr.
Seaman, Lawrence
Waite, Earle C.
*Warriner, Jesse B.

BETTIS SITE

Westinghouse Elec. Corp.
Stevenson, George P., Jr.

BLAIRSVILLE

Graff Engrg. Co.
*Graff, Paul W.
North American Machine Co.
Duchnowski, Henry E.

BOYERTOWN

Kawecki Chemical Co.
Kawecki, Henry C.

BRACKENRIDGE

Allegheny Ludlum Steel Co.
Hilliard, Glenn E.

BRIDGEPORT

Bethlehem Limestone Co.
Ellington, T. S.
Sharples Corp.
Payne, Robert E.
No Data Supplied
Demos, Anthony C.

BROCKWAY

Brockway Glass Co.
Locotos, Frank M.
*Robertson, Leon F.

BRIDGEVILLE

Geo-Drill Co.
*Barrett, James L.
No Data Supplied
*Meyer, D. W.

BRYN MAWR

Bryn Mawr College
*Watson, Edward H.

BUTLER

Ferrosag Process Corp.
Rath, Robert A.
Harcos Corp.
Jones, W. K.
Macin, Inc.
Morgan, William A.

No Data Supplied
Hagen, Robt. E.

CALIFORNIA

Jones & Laughlin Steel Corp.
Hess, Wm. E.
Howe, Donald C.
Reilly, J. J.

CARBONDALE

Hendrick Mfg. Co.
Blackburn, D. McM.
Colville, K. H., Jr.
No Data Supplied
Dann, B. C., Jr.

CARLISLE

Carlisle Corp.
Dixon, George F., Jr.

CARMICHAELS

No Data Supplied
Connor, Jack W.

CARNEGIE

S. P. Kinney, Engrs., Inc.
*Kinney, S. P.

CATASAUQUA

Fuller Co.
Johnson, Robert M.
Williams, John C.
No Data Supplied
Feenstra, Wm.

CENTER VALLEY

N.J. Zinc Co.
Barfas, Joseph N.
Childs, Mark S.
Crouch, Gordon H.
Huyett, Sterling S.
Lanning, Mayo W.
Moels, Noel N.
Seip, Robert H., Jr.
Wiles, H. B.

CHARLEROI

Lee Norse
Arentzen, Einar M.
Fitzgerald, Harry J.

CLAIRTON

U.S. Steel Co.
Walls, Robert L.
*Wright, R. E.

CLARKS SUMMIT

No Data Supplied
Conroy, W. E.

CLEARFIELD

Maple Hill Coal Co.
Davidson, Alan R.
No Data Supplied
Crum, Stanley E.

COALPORT

No Data Supplied
Reilly, James P.

COATESVILLE

Lukens Steel Co.
Bomberger, John C.
*Potter, H. W.
Steidle, Howard

COLMAR

Link-Belt Co.
Bottorf, Robert G.

CONSHOHOCKEN

Alan Wood Steel Co.
*Schenck, W. P.

CONYNGHAM

No Data Supplied
Owens, Harry C.

COOPERSBURG

No Data Supplied
Griffith, Geo. L., Jr.

COPLAY

Coplay Cement Mfg. Co.
*Uhle, David J.

CORAOPOLIS

Am. Minechem Co.
Messier, Leonard

CORNWALL

Beth-Cornwall Corp.
Brown, Nathan
*Eben, C. Frederick
Hosford, Phillip N.
Lipensky, Milan
Neil, Charles R.
Peets, Robert G.
Perhac, George A.
Renfrew, Robert T., Jr.
Shale, S. J.
Taylor, Charles E., Jr.
Weik, William J.
Wheeler, Robert M.
White, Frank P.
No Data Supplied
Bernhardt, Joseph

CRESSON

No Data Supplied
Evans, M. Albert

CRUCIBLE

Crucible Steel Co. of Am.
Tilson, Chas. B., Jr.

DALLAS

No Data Supplied
Fouike, R. W., Jr.
*Matthews, Charles H.
*Mulcey, Paul A.
Tremayne, W. Earl

DOYLESTOWN

No Data Supplied
*Duey, Robert K.

DREXEL HILL

No Data Supplied
*White, Paul F.

DRIFTON

No Data Supplied
Coxe, Daniel M.

DU BOIS

Kline Engrg. & Contr. Co.
Kline, F. C.
No Data Supplied
*Gillette, G. Marshall

DUNMORE

No Data Supplied
Foster, Ralph K.

DUPONT

No Data Supplied
Kosik, Michael J.

EAGLES MERE

No Data Supplied
Holstein, L. S.

EASTON

Alpha Portland Cement Co.
Ames, John A.
Brownstead, E. F.
Magee, John F.
Easton Car & Construction Co.
Farrell, Cottrell
Gen. Crushed Stone Co.
Kemery, Harry W.
Parton, W. Julian
Lafayette College
Montgomery, Arthur
No Data Supplied
Bailey, E. G.

EBENSBURG

Bethlehem Steel Co.
Ferguson, Peter A.
Reed, Robert F., Jr.

ELLSWORTH

Bethlehem Steel Co.
Sprague, Luther S.
No Data Supplied
Ward, John D.

ELLWOOD CITY

No Data Supplied
Pawol, Joseph

ELVERSON

No Data Supplied
Rasey, Weston G., II

ELYSBURG

No Data Supplied
Harvey, A. H.

ERIE

Gen. Elec. Co.
Brauns, John W.

FAIRCHANCE

No Data Supplied
Peters, F. W.

FAIRLESS HILLS

U.S. Steel Corp.
Parker, Howard A.
*Webb, William R.

FINLEYVILLE

Mathies Coal Co.
*Kebblish, William

FORTY FORT

No Data Supplied
Arbogast, K. F.
Decker, R. G.
Eaton, Walter L.
Meyer, Karl A.

FRACKVILLE

Read Realty Co.
Haupt, David F.
No Data Supplied
Beacher, Arthur F.
Crane, Joseph J.
Lewis, Thomas J.

FRANKLIN

Joy Mfg. Co.
Barrett, A. Lee
*Calder, A. William
Osgood, Charles F.
No Data Supplied
Greer, Robt. Dale

FREELAND

No Data Supplied
Johnson, Harold W.
Poler, Ralph
Wassel, M. J.

GETTYSBURG

No Data Supplied
Bianchetta, P. F.

GIBSONIA

No Data Supplied
Trump, Robert P.

GILBERTON

Gilberton Coal Co.
Christ, E. S.
*Smith, Gordon E.

GLASSMERE

No Data Supplied
Kuchta, Bernard R.

GLEN LYON

Susquehanna Collieries Co.
Farrell, Michael F.

GOODSPRINGS

Penag Coal Co.
*Riedel, Alfred B.

GREENSBURG

Old Republic Ins.
*Glance, Arthur S.

GREENSBORO

No Data Supplied
Durfee, John C.

GREENSBURG

Jamison Coal Co.
*Jamison, Will B.
Nat'l. Mine Service Co.
Schubert, R. R.
South Union Coal Co.
Jamison, David S.
No Data Supplied
Kelley, Jay H.

GWYNEDD VALLEY

No Data Supplied
Enck, Ernest G.

HAMLIN

No Data Supplied
Gale, Paul B.

HANOVER

No Data Supplied
Bremen, Fred J.
Thomas, Francis H.

HARRISBURG

Anthracite Comm.
Corgan, D.L.
Andrew S. McCreath & Son, Inc.
*Pennington, Fred A.
Penna. Dept. of Mines & Min. Ind.
*Becker, N. F.
*Howell, Roger J.
*Lovell, George H.
*Maginnis, Joseph B.
Maize, Clyde H.
Pennsylvania Turnpike Comm.
*Smith, James D.
No Data Supplied
Berner, Clarence E.
Crichton, Edw. B.
Montgomery, Hugh B.

HAVERFORD

Allis Chalmers Mfg. Co.
Edwards, Albert I.
Penna. Dept. of Highways
*Zimul, N. F.
Warner Vaughn Co.
Vaughn, Warner G.

HAZLETON

Barrett Haentjens & Co.
Heantjens, W. D.
*Rubert, C. D.
Central Pa. Quarry Stripping & Constr. Co.
Butler, W. C. M.
Butler, William C. M., Jr.
Welliver, Robert M.
Chisnell Coal Co., Inc.
*Chisnell, George M.
Correale Construction Co.
Correale, Fred R.
Correale, Palmer
Dick Construction Co., Inc.
*Dick, Donald B.
A. E. Dick Contracting Co.
Dick, Arthur E., Jr.
Kuech, Luther E.
Hercules Powder Co.
Botsford, Robert B.
Wilson, John H.
Frank Swabb Equip. Co.
Swabb, Frank L.
Vibration Engrg. Co.
Petro, A. J.
No Data Supplied
Bender, John R.
Boddin, Charles H.
Butler, Charles T.
Capparelli, S. T.
*Carner, Carroll A.
Hildebrand, J. F.
Lubrecht, F. S.
Mitchell, D. L.
*Price, Harold L.
Roderick, David J.
Schwartz, Arthur D.

HOMETOWN

Scraffords, Inc.
Murray, Roger, Jr.

HOUSTON

No Data Supplied
Rozance, John L.

HUNKER

Delmont Fuel Co.
Tenley, James L.

IMPERIAL

No Data Supplied
Kislosky, Chester

INDIANA

Daniels Co.
*Daniels, Herman J.
Rochester & Pittsburg Coal Co.
Bullers, Walter E.
Calhoun, F. F.
Cheely, E. M.
Hunter, Ralph M.
Kennedy, C. H.

Potter, C. J.
 *Snure, John J.
 *Yeloushan, Charles C.
 No Data Supplied
 *Barrett, Orrin T.
 Dunn, Gordon H.
 Householder, L. W.
 Jones, Sheldon
 Sherwin, Lee A.

INGOMAR

No Data Supplied
 Burge, Furman H., Jr.

IRWIN

Irwin-Sensenich Corp.
 Sensenich, Chester G.
 Sensenich, Gray F.

ISABELLA

Nat'l. Mines Corp.
 Rigg, George M.

ITHAN

No Data Supplied
 Ceer, Irving S.

JEANNETTE

No Data Supplied
 Sisti, Dominick C.

JEDDO

Jeddo Highland Coal Co.
 Davis, Edward E.
 Holland, George H.
 Jones, Wilmot C.
 *Markie, Donald
 Markie, Donald, Jr.
 *Robinson, Edward Moore
 No Data Supplied
 Sharpe, Edward J.

JENKINTOWN

No Data Supplied
 Kessler, H. H.

JENNERS

Ely & French
 *Ely, Richard C.

JOANNA

No Data Supplied
 Carthew, Douglas

JOHNSTOWN

Bethlehem Mines Corp.
 Brisky, Theodore J.
 Chalfant, L. H.
 Cressman, Charles S.
 Hannigan, C. J.
 Korber, Edmund J.
 Cimba-Hinks Coal Co.
 *Hinks, Warren H., Jr.
 Crichton Coal & Coke Co.
 *Crichton, Andrew B., Jr.
 U.S. Rubber Co.
 Rostovsky, A., Jr.
 No Data Supplied
 Haynes, W. R.
 Hinks, Warren H.
 Joseph, Roy D.
 Slick, E. E.

KENNERDELL

No Data Supplied
 Morrow, C. P.

KINGSTON

E. I. Du Pont de Nemours & Co.
 *Kay, W. W.
 Elec. Storage Battery Co.
 Kehl, C. Joseph
 Lehigh Valley Coal Co.
 *Humphrey, J. M., Jr.
 Weatherholt, H. S.
 State Equip. Co.
 Wright, Lundy R.
 No Data Supplied
 Adonizio, Pat, Jr.
 Biscontini, A. L.
 Corgan, John B.
 Corgan, Leo R.
 Corgan, William H.
 Edfort, Ralph J.
 Gleason, Benjamin
 *Giese, William B.
 Keller, Henry K.
 Kenworthy, O. E.
 Kudlich, Franz E.
 Price, Thomas C.
 Randall, H. R.
 Reese, H. R.
 Weichel, Thomas R.
 Whafte, R.

LANCASTER

Am. Testing Laboratories
 *Stickler, Chas. W., Jr.
 Mac-It Paris Co.
 Roth, William B.
 Mayo Tunnel & Mine Equip.
 *Mayo, Robert S.

LANGELOTH

Climax Molybdenum Co.
 of Pa.
 *Wheeler, E. S.

LANSDALE

No Data Supplied
 Vaughan, C. D., Jr.

LANSFORD

Lehigh Coal & Navigation Co.
 Evans, Evan
 Sterner, Francis E.
 De Tauretis Cont. Co.
 Delauretia, A. J.
 No Data Supplied
 Arner, Henry E.
 Rickert, E. E.

LARKSVILLE

Glen Alden Coal Co.
 Richards, Edward

LATROBE

Am. Cyanamid Co.
 McKenna, Leroy
 Kennametal, Inc.
 Engle, Edgar W.
 McKenna, Philip M.
 No Data Supplied
 *Phemister, Harry I.

LAURELDALE

No Data Supplied
 Thomas, Russell C.

LEBANON

Bethlehem-Cornwall Corp.
 Anderson, Arvid E.
 Ball, Samuel S.
 Bomser, Donald
 Harris, William W.
 Schumacher, Charles R.
 Bethlehem Steel Co.
 Dominguez, E. C.
 Fegan, Lloyd V., Jr.
 Horst, Russell J.
 Larpenteur, Bernard J.
 Moyer, William H.
 Walter, A. R.
 Calcite Quarry Corp.
 Patton, George E., Jr.
 No Data Supplied
 Fredericksen, T. R.
 Meyer, Simon J.

LEHIGHTON

No Data Supplied
 Elsasser, Charles B.

LEWISBURG

No Data Supplied
 Fetherston, John T.

LEWISTON

No Data Supplied
 Guerrini, S. Joseph

LIBRARY

Consolidation Coal Co.
 *Blandford, T. E., Jr.
 *Hanson, Victor D.
 Hays, C. M.
 Kirk, Earl C.
 Rose, Henry C.
 Sylvander, Neils E.
 Tarleton, George O.
 Vonfeld, J. M.
 No Data Supplied
 Clark, Joseph T.
 Engott, Joseph R.

LIGONIER

Garfield Refractories Co.
 Rugh, Kenneth A.

LOCUST GAP

No Data Supplied
 Havrocky, Edw. R.

MAHONNY CITY

No Data Supplied
 Kerbetky, Jos. T.
 Pearson, F. C.

MARCUS HOOK

Fenix & Scisson, Inc.
 Geary, Daniel

MATHER

Pickands-Mather & Co.
 Brookes, J. Allen

MINERSVILLE

No Data Supplied
 Williams, Wm. G.

MONACA

St. Joseph Lead Co.
 Long, Carleton C.
 Mitchell, Robert F.
 Najarian, H. K.
 No Data Supplied
 Weston, George F.

MONESSEN

Pittsburgh Steel Co.
 Bailey, David R.

MONROEVILLE

U.S. Steel Corp.
 Ciendenin, J. Donald
 Phelps, Donald D.
 Price, J. G.
 Reed, Thomas F.
 Romig, O. E.
 Shoenberger, R. W.
 No Data Supplied
 McKee, D. W.

MORGANTOWN

Bethlehem Cornwall Corp.
 Bingham, John P.
 Ketter, Richard P.
 *Lee, Edward J.
 Leske, Reinhold H.
 McCann, Robert M.
 *Sleeman, Robert W.
 Bethlehem Steel Co.
 Sheary, Geo. W., III
 No Data Supplied
 Anspach, David M.

NORRISTOWN

No Data Supplied
 Leedecker, E. K.

MOUNTAIN TOP

No Data Supplied
 Biscontini, Arnold

MT. CARMEL

No Data Supplied
 Morgan, Edmund F.

NANTICOKE

Glen-Nao Mining Co.
 Goepfert, Albert R.
 M. A. Hanna Co.
 Gibbons, Charles Allen
 Jones, D. W.
 No Data Supplied
 Christian, Wm. E.
 Davis, Thomas E.
 Haas, Raymond F.
 Kienzie, Geo. H.
 Williams, Ivor L.

NAZARETH

Lone Star Cement Co.
 Embree, Francis P.
 Nazareth Cement Co.
 Scott, Herbert J.
 Penn-Dixie Cement Corp.
 Scott, Richard P.

NEMACOLIN

Buckeye Coal Co.
 Lindstrom, Charles J.
 Trevorror, George C., Jr.
 No Data Supplied
 Hanish, William R.

NESQUEHONING

Diester Concentrator Co.
 Bilas, R. T.
 No Data Supplied
 Fauzio, Frank P.
 Fauzio, James

NEW CASTLE

U.S. Steel
 Luttrell, Eugene M.
 Sullot, J. N.

No Data Supplied
 Baker, Ralph L.
 Crisci, Anthony
 Kurtz, Edward L.
 Micco, John C.
 Otto, John F.

NEW KENSINGTON

Alcoa Res. Lab.
 Dowd, James D.
 No Data Supplied
 Schuck, Chas. W.

NORTHAMPTON

Dragon Cement Co.
 *Anderson, Frank J.
 Lehigh Valley Air Poll. Cont.
 Doherty, R. Emmet
 Universal Atlas Cement
 Schank, Charles G.
 No Data Supplied
 Anthony, Stanley E.
 Kowalshyn, T. J.

OAKMONT

No Data Supplied
 *Eckhardt, E. A.
 Graff, F. Malcolm

ORWIGSBURG

No Data Supplied
 Jones, John Edward

OXFORD

No Data Supplied
 Gillingham, T. E.

PALMERTON

N.J. Zinc Co.
 Brubaker, D. G.
 Freyberger, Wilfred L.
 Fuller, M. Luther
 Lupton, D. Keith
 Rodda, John Landon
 No Data Supplied
 McGarry, Phillip E.

PALMYRA

No Data Supplied
 Harmon, Richard C.

PAOLI

Foot Mineral Co.
 Crawford, Brodie E.
 Shay, Felix B.

PAXINOS

No Data Supplied
 *Weysser, John L. G.

PECKVILLE

No Data Supplied
 Stonebraker, W. I.

PHILADELPHIA

Aero Service Corp.
 *Agocs, W. B.
 Hess, George L.
 Jensen, Homes
 *Oppermann, A. J.
 Allis-Chalmers Mfg. Co.
 Seward, Donovan R.
 Am. Engrg. Co.
 Belsak, Frederick C.
 Am. Pulley Co.
 Rohins, James H.
 Atlantic Ref. Co.
 Lankris, L.
 Berwind-White Coal Mining Co.
 Berwind, Chas. G.
 Berwind, Chas. G., Jr.
 Blocked Iron Corp. of Am.
 Longo, John S.
 Puskar, Victor
 Chain Belt Co.
 Davis, Calvin R., Jr.
 W. W. Criswell Co. Inc.
 Criswell, W. W., Jr.
 Foote Mineral Co.
 Chambers, Gordon H.
 Eldon, Wm. A. C.
 Raynor, Wm. M.
 Gardner Denver Co.
 Malmgren, C. E.
 Tolosky, R. R.
 Gen Refractories Co.
 Blinzler, Lee E.
 *Coddington, Samuel L.
 Rappold, William F.
 Thorpe, Drew M.
 Greenberg Engrg. Co.
 *Greenberg, Wm. B.
 Griswold, McLean & West
 West, Alan D.

Pennsylvania-Pennsylvania

Grubnau Bros. Inc.
 Grubnau, V. Carl
 Janney, Dues & Battles, Inc.
 Focht, Dexter
 Johnson-March Corp.
 Mau, George A.
 E. J. Lavino & Co.
 Heck, Frank G.
 Leith, Andrew
 Miller, Jesse A.
 Montgomery, Scott & Co.
 Bayley, W. D.
 Morrisdale Coal Min. Co.
 Wigton, R. W., Jr.
 On-the-Job-Fire-Protection
 *Batzer, M. M.
 Pennsylvania RR. Co.
 Teichman, Richard A., Jr.
 Geo. F. Pettinos, Inc.
 Harris, A. T., Jr.
 Pettinos, Geo. F., Jr.
 Philco Corp.
 Grove, William B.
 W. L. Roller Co.
 *Roller, W. L.
 Ben F. Schaberg Co.
 *Schaberg, Ben F.
 Stonega Coke & Coal Co.
 *Humphrey, E. P.
 United Engs. & Constructors, Inc.
 *Peller, Leonard
 Warner Co.
 Shoemaker, E. L.
 Westmoreland Coal Co.
 Gallagher, W. A.
 No Data Supplied
 Allen, Henry Butler
 *Cameron, Frank
 Davis, Daniel J.
 Downing, Thos. F., Jr.
 Gilbert, John
 Jaffe, Arthur
 Matthies, Albert J.
 Meyer, H. C.
 *Millington, William Parkes
 Moerk, Frank N.
 Stephano, C. S.
 Wetter, J. William

PHOENIXVILLE

Phoenix Steel Corp.
 Milos, John

PINEGROVE

No Data Supplied
 Peterson, J. N.

PITCAIRN

No Data Supplied
 Kantor, Andrew J.

PITTSBURGH

Allegheny County Sanitary Authority
 *Forlund, Evar John
 Aluminum Co. of America
 Bell, Peter M.
 Brown, Charles K.
 Franke, Herbert A.
 Harrison, Edward, Jr.
 Litchfield, Lawrence, Jr.
 McWilliams, Jack H.
 Miller, Roy F.
 Neustadter, James A.
 Stroepey, Geo. W.
 American Brake Shoes Co.
 Maley, Geo. E., Jr.
 American Metallurgical Prod.
 Bolckcom, Wilbur T.
 Geo. S. Baton & Co.
 *Baton, Charles B.
 *Watters, E. A., Jr.
 Bituminous Coal Res., Inc.
 Rose, Harold James
 Bogner & Co., Inc.
 Leibold, Harold G.
 Callery Chemical Co.
 Toering, A. J.
 Coal Age & E. & M. J.
 Gieder, Wm. H. H.
 Columbia-Southern Chem. Corp.
 Hippler, Robert F.
 Consolidation Coal Co.
 Cassidy, S. M.
 Davis, David H.
 Forester, Max H.
 Gamba, Gerard C.
 *Gasper, Donald
 Hall, Ernst F.
 Ireland, M. H.
 Kennedy, James P.
 Lamb, George A.
 Love, George H.
 Matthews, A. H.
 McElroy, Dennis L.
 Pursglove, Joseph, Jr.
 Shoemaker, G. Albert
 Crucible Steel Co. of Am.
 Chang, Mohrin Chen-Siang
 Muss, George E.

Pennsylvania-Pennsylvania

- E. P. Dandridge Co.
Herb, James H.
Dictating Equip. Corp.
*Bogan, Joseph A., Sr.
Dominion Gulf Co.
Wyckoff, Ralph D.
Dravo Corp.
Anthes, John A.
Banning, A. Tanner
Berg, Philip J.
Engelsteiner, William H.
Nilsen, A. A.
Price, William L.
*Rausch, Donald O.
E. I. Du Pont de Nemours
SchAAF, Heribert L., Jr.
Duquesne Light Co.
Draper, John C.
Elkin, James E.
Younkins, James A., Jr.
Eastern Gas & Fuel Assoc.
Allsbrook, S. T.
Boxley, A. P.
Burton, E. B.
Griffin, John P.
Johnston, James C.
*Krickovic, Stephen
Llewellyn, R. L.
Rothenhoefer, Walter
Sawyer, Chas. H.
Evenson, Auchmuty &
Greenwald
*Auchmuty, R. Laird
*Greenwald, G. H.
Equitable Gas Co.
*Tilton, James G.
Firth-Sterling, Inc.
Redmond, John C.
Fishback & Moore
*Gallagher, Patrick V.
John W. Galbreath & Co.
*Hollinshead, Earl D.
Gardner-Denver Co.
Nichols, Donald C.
General Electric Co.
Drisko, J. W.
Kinsley, H. D.
Goodman Mfg. Co.
Caine, K. E.
Gulf Oil Corp.
Gealy, Wendell B.
Harbison-Walker Ref. Co.
Cook, Charles P.
Galbraith, Scott Paul
*Wicken, Oscar M.
J. H. Hillman & Sons Co.
Affelder, William Lewis
Stevenson, William G.
Interstate Equip. Corp.
*Vogel, Leo J.
Island Creek Coal Sales Co.
McCarthy, Jerome C.
Jeffrey Mfg. Co.
Howell, John P.
Jones & Laughlin Steel Corp.
Beutner, Edward L.
*Brown, Dwight C.
Cooper, E. R.
*Crump, Robert M.
Getty, William P.
Henning, Carl C.
Lichy, Charles M.
*Linden, John F.
Morris, Jack E.
Peterson, Harry S.
Fotter, C. L.
Sleeman, Clarence H.
Stowasser, W. F., Jr.
Turner, H. S.
Joy Mfg. Co.
Butters, Howard E.
*Courtright, John P.
Drain, James A.
Felderman, L. G.
Gent, L. D., Jr.
Hair, Richard T.
Lehner, Ray A.
Lockhart, A. J.
*Morrow, J. D. A.
Niquist, Hugo C.
Russell, John D.
Sheriger, Paul M.
Smith, Darrell
Van Houten, Herman
Vard, Joseph E.
Wearly, William L.
Williams, Melvin E.
Koppers Co. Inc.
Donath, Dr. E. E.
Rice, Owen R.
Rose, E. H.
Thiessen, Gilbert
Link Belt Co.
Werner, O. W.
Mfrs. Light & Heat Co.
Romer, Robert A.
Mellon Institute
Weidlein, Dr. Edawrad R.
Mine Safety Appliance Co.
Bright, Graham
Deike, George H.
Deike, George H., Jr.
*Hogan, John E.
Johnson, Henry R.
Redenbaugh, H. E.
Ryan, John T., Jr.
Stanton, V. A.
Walsh, Robert R.
White, Everett M.
Natl. Mine Service Co.
MacVean, Gordon
Northwest Magnite Co.
Sargent, C. A.
Orinoco Mining Co.
LeBlanc, J. E., Jr.
Pennsylvania Drilling Co.
Melvin, John H.
Parse, Richard G.
*Sturges, Frank C.
Wilson, Robert W.
Peoples Natural Gas Co.
Donaldson, George J., Jr.
Pierce Management Corp.
*Gustafson, Karl E.
Pittsburgh Coke & Chem. Co.
*Marshall, C. T.
J. F. Pritchard & Co.
Spangler, C. V.
Republic Steel Corp.
Murray, John C.
Roberts & Schaefer Co.
Middleton Ray T.
Rust Engrg. Co.
Robinson, T. H.
St. Laurence Fluorspar, Inc.
Keaney, Robert C.
Shenango Furnace Co.
Brown, Fayette, Jr.
J. K. Smith & Sons, Inc.
Morander, Harold G.
E. S. Stickle Co.
Riehl, August H.
Tasa Coal Co.
*Bartony, Henry E.
Travelers Insurance Co.
Kovash, Louis S.
M. H. Treadwell Co.
Weniger, Oscar S.
U. S. Bureau of Mines
Bolmer, Robert L.
Dowd, James J.
*Evans, Robert Lee
Feitler, Stanley A.
Gray, Thomas E.
*Kingery, Donald S.
*Magnuson, Malcolm
*Maize, Earl R.
*Merritt, William M.
Nagy, John
Palowitch, Eugene R.
Polack, Samuel P.
Shields, Joseph J.
*Stahl, R. Ward
*Thomas, Edward
Thomson, Robert D.
U. S. Steel
Barnhart, A. C.
Becker, F. M.
Beinlich, J. J.
Blackwood, Harold T.
Brise, A. H.
Chase, P. W.
Coy, Richard J.
Ferguson, J. Robert, Jr.
Fisher, Warren E.
Keller, George E.
Knapp, R. Herbert
Lesperance, Robert L.
Lloyd, R. M.
Martin, James S.
McCa, Donald R.
McMorris, W. L., Jr.
Morris, Roger D. C.
Nelson, E. B.
Peterson, Almer J., Jr.
*Richards, P. L.
Stacy, M. C.
*Strain, Harry A.
Sweeney, James F.
Werft, Harold H.
Williams, C. H.
Wilson, Philip J., Jr.
Univ. of Pittsburgh
*Dines, Edward A.
*Norman, K. Flint
*Tartaron, Francis X.
Westinghouse Elec. Corp.
Rector, B. E.
Risler, Clark B.
Thomas, Walter E.
Whitney Chain Co.
*Pyle, Paul F.
J. W. Woerner & Assoc.
Hinkle, Melvin E.
*Woerner, J. W.
No Data Supplied
*Alford, Newell G.
Baker, Donald J.
Barnes, Robert W.
Barry, Anthony J.
Bateman, Robert N.
Beglinger, Richard T.
Breitenstein, A. J.
Brown, Thomas E.
Calverley, Jos G.
*Campbell, L. C.
*Campbell, Robert W.
Casper, Marion
Chisholm, John A.
Cooper, Maurice D.
Core, Jesse F.
Dengler, T. J.
Dodge, Chas. H.
Dodsworth, J. R., Jr.
Donahue, C. M.
*Dorfan, Morton I.
*Dorfan, Morton I.
Dougherty, R. E., Jr.
Eathorne, William
*Griffen, John
*Greenwald, H. P.
Haen, Jack D.
*Hebley, Henry F.
Kennedy, Andrew M.
Kennedy, Julian
Konnerth, K. L.
Leech, W. A., Jr.
Leonard, Joseph W.
*Lesher, Carl Eugene
Lewis, Walter H.
Lusk, H. C.
*McCa, George S.
McElroy, G. E.
Montag, H. A.
*Morrow, J. B.
*Palmer, Rufus N.
Querr, Thos. H.
Rains, L. F.
Redding, James A.
Reinkensmeyer, N. W.
Russell, Charles C.
Russell, Freeman L.
Shallenberger, J. M.
*Shipley, Grant B.
Snell, Wayne D.
*Snouffer, Richard D.
Strod, A. J.
Tallon, Walter A.
Talmann, Woods G.
Thiessen, Linwood
Tisdale, Rowland A.
Walker, J. L., Jr.
*Whisenant, R. N.
Whitzel, Raymond T.
Zannoli, Stelio W.
REYNOLDS
Atlas Powder Co.
Ziminsky, George L.
RIMERSBURG
No Data Supplied
Welch, Dick W.
ST. CLAIR
No Data Supplied
Thomas, Edward T.
ST. DAVIDS
No Data Supplied
Canning, T. V.
ST. MICHAEL
No Data Supplied
Oelka, John M.
SALTSBURG
Joy Mfg. Co.
Wiebe, Donald
SCHUYLKILL HAVEN
Lincoln Anthracite Co.
*Fox, Edward George, III
U. S. Bureau of Mines
Brady, George A.
Eckerd, James W.
*Ingersoll, Dallas E.
Jacobs, Howard D.
Kuebler, C. S.
Link, Howard B.
No Data Supplied
Bailey, Harold L.
Buch, John W.
SCRANTON
D. L. & W. R.R.
Ruth, H. M.
Herold Mfg. Co. Inc.
Herold, Walter L.
Hudson Coal Co.
Fillmore, G. Ben
Griffiths, John T.
Petzold, W. B.
Wiegand, August J.
*Zink, Charles G., Jr.
Ingersoll-Rand Co.
Earl, John C.
Intl. Salt Co.
Parrish, Floyd G.
Moffat Coal Co. Inc.
Lamb, Earl W.
Pennsylvania Appra. Co.
Bell, Robert W.
Perry Construction Co.
Fink, Nathan
Pierce Management, Inc.
*Marshall, John S.
*Pierce, James H.
Sprague & Henwood, Inc.
Fornwald, William L.
Ross, Adrian E.
Ross, James A.
Schantz, Wm. J.
No Data Supplied
Harding, Leo A.
Lambert, Ralph A.
*Lesser, William H.
Otto, Henry H.
SHAMOKIN
M. A. Hanna Co.
Moore, William H.
Penag Coal Co.
*Twigg, Edward V.
No Data Supplied
Dunkin, Ned R.
Fetterman, James
Prosser, J. W.
Shomper, Harold E.
SHARON
Sawhill Tubular Products Inc.
*Wolcott, Frank B.
SHENANDOAH
Reading Anthracite Co.
Erment, Emil R.
SLICKVILLE
No Data Supplied
Helfer, R. W.
SLIPPERY ROCK
No Data Supplied
*Mitchell, Russell S.
SOUTH FORK
No Data Supplied
Golas, F.
SPRINGFIELD
No Data Supplied
Gillan, C. A., Jr.
STUMP CREEK
Northwestern Ming. & Exch.
Co.
Peterson, Carl A.
STATE COLLEGE
Pa. State Producers Guild
*Mullen, Willard F.
No Data Supplied
*Fleming, Robert M.
Keim, James W.
Merrin, Seymour
SUGARLOAF
No Data Supplied
Altmiller, C. H., Jr.
SUMMITT
No Data Supplied
Renner, Fritz
TAMAQUA
Atlas Powder Co.
Simpson, Robert A.
No Data Supplied
Mariner, J. D. A.
THOMASVILLE
Thomasville Stone & Lime Co.
Brigstocke, H. D.
TREMONT
No Data Supplied
Hatter, Fred C.
TRUCKSVILLE
No Data Supplied
Neil, William
Shepherd, Robert D.
TURTLE CREEK
No Data Supplied
Notary, J. A.
UNIONTOWN
Republic Steel Co.
Reed, Frederick J.
U. S. Steel Corp.
Beerbower, R. C., Jr.
Cirod, James B.
Kodrowsky, William G.
Moran, Archie E.
Saari, George J.
Werft, August R.
No Data Supplied
Bertoni, A. P.
Coe, G. Dale
George, J. C.
Neely, Frank H.
Zeller, Wm. L.
UNIVERSITY PARK
Penn. State Univ.
*Chambray, H. B.
Cook, Donald J.
*Falkie, Thomas V.
*Hartman, Howard L.
*Hoffman, John N.
*Kochanowsky, Dr. Boris
Maneval, David R.
*Mitchell, David R.
*Ridge, John
Rusinko, Frank, Jr.
*Schanz, John S., Jr.
Sohn, Robert S.
*Spicer, Theodore S.
Stefanko, Robert
Steidle, Edward
*Sun, Shicou-Chuan
VILLANOVA
Villanova Univ.
Venuto, C. Joseph
WAMPUM
Medusa Portland Cement Co.
Weaver, Kenneth N.
WASHINGTON
Frazier-Simplex, Inc.
*Frazier, John E.
R. G. Johnson Co.
Johnson, S. C.
No Data Supplied
Hannon, J. W. G.

WAVERLY

No Data Supplied
Evans, C., Jr.
Ried, John M.

WAYMART

No Data Supplied
Schreckengost, E. D.

WAYNESBURG

No Data Supplied
Saxe, J. Arch

WEATHERLY

No Data Supplied
Jeppsen, Harold C.

WEST CHESTER

Bath Iron Works Corp.
*Adams, Robert A.
No Data Supplied
Weldin, William A.

WEST MIFFLIN

Westinghouse Elec. Corp.
Goetz, Lorenz J.

WEST PITTSBURGH

Mammoth Coal Co.
*Lambert, Kenneth A.

WEST WYOMING

No Data Supplied
Adonizio, Charles
Talamelli, Velio

WHEATLAND

Wheatland Tube Co.
*Leisy, R. Warren

WHITE HAVEN

Wilmot Engrg. Co.
Gilbert, A. G.
*Hammonds, Haydn
Hensker, Harry C.
*Ippoliti, Joseph E.
Jenkins, Carl S.

WILKES BARRE

Am Chain. & Cable Co. Inc.
Todo, Emerson H.
Cleveland Bros. Equip. Co.
Rinehimer, E. D., Jr.
Glen Alden Coal Corp.
Bradbury, Harry W.
Devens, Willis R.
Eichler, Tobias
Klippel, Fred L.
Stortz, Alfred F.
Wagner, Charles W.
Goodman Mfg. Co.
Sanders, Floyd S.
Morris Run Coal Min. Co.
*Haddock, John C.
Pa. Dept. Mines & Mineral Ind.
Dennen, William L.
Pa. Turnpike Comm.
Leitner, Louis H.
U. M. W. A. District #1
*Lippi, August J.
Wilkes Barre Iron Mfg. Co.
Smith, Ralph O.
No Data Supplied
Aston, Trevor
*Everett, William W.
Farrell, Francis X.
Jones, C. B.
*MacCartney, John C.
Rowlands, Richard

WILMERDING

No Data Supplied
Lowry, H. H.

WINDBER

Berwind-White Coal Ming. Co.
Miller, Franklin
No Data Supplied
Seese, Robt. H.

WYNEWOOD

Allen-Sherman-Hoff Pump Co.
Allen, Homer E.
Ashe, Donald G.
Keyser, James M. B.
Stephenson, Wm. B.

WYOMING

No Data Supplied
Cooke, Michael K.

YARDLEY

No Data Supplied
Campbell, Morris W.

YATESVILLE

No Data Supplied
Capone, Patrick J.

YORK

J. E. Baker Co.
Duersmith, L. J.
Hardinge Co., Inc.
Brown, C. Blair, Jr.
Downes, H. Sidney
Hardinge, H. DeForest
*Hardinge, Harlowe
*Lacy, Chancellor E.
*Zuercher, Edgar M.
Natl. Gypsum Co.
Mensing, Henry E.
Supreme Supply Co. Inc.
*Frey, John P.
No Data Supplied
Russell, R. J.
Frey, W. S.
Paul, Robert A.

ZELIENOPLE

No Data Supplied
Letts, Harold D.

ZERBE

No Data Supplied
*Zerbe, T. W.

RHODE ISLAND

ESMOND

No Data Supplied
Owen, F. James

PROVIDENCE

Peerless Precision Prod.
World Mfg. & Consult., Inc.
*Morgan, David E.
No Data Supplied
Brown, Charles W.

SOUTH CAROLINA

AIKEN

E. I. Du Pont de Nemours &
Wills, Wm. A.
No Data Supplied
Godla, J. J.
Laird, H. C.
Perry, O. H.

CLOVER

Commercialores
Strohl, John J.

COLUMBIA

No Data Supplied
*Taber, Stephen

ENOREE

Zonolite
Stewart, Otis F.

GREENVILLE

No Data Supplied
Marks, Geo. M., Jr.
Ulery, Charles R.

MYRTLE BEACH

No Data Supplied
Lee, Whitford J.

SPARTANBURG

No Data Supplied
Skardon, A. H.
Hash, Lewis J.

TRAVELERS REST

Zonolite Co.

YORK

Industrial Minerals, Inc.
Beers, S. J.
Wilson, L. C.

SOUTH DAKOTA

BELLE FOURCHE

Int. Min. & Chem. Corp.
Beeman, Fred A.
National Lead Co.
Colins, R. Keith
Martin, James D.

EDGEMONT

Mines Development Inc.
Hoffman, John E.
Webb, Harold D.
No Data Supplied
Richards, G. F.
*Seerley, John J.

KEYSTONE

*Johnson, A. I.
Mitchell, John W.

LEAD

Homestake Mining Co.
Campbell, Wm. C.
Driscoll, R. E., Jr.
*DuMontelle, Paul B.
Gallo, Renaldo D.
*Gust, Cedric L.
Harder, James O.
*Howell, Frank M., Jr.
Kellar, Kenneth C.
*Mathiasrud, Gordon C.
Mosley, Fred H.
Richards, Richard H.
Schmidt, Claude E.
Slaughter, Arch L.
Tario, Rex
Waterland, Joel K.
*Woolenberg, H. A.
No Data Supplied
Broome, John
Fielder, Ronald G.
*Herz, Nathaniel
Jones, William S.
Kravig, C. N.
Northland, George N.
Rosa, Ed C.
Ryan, W. E.

MADISON

No Data Supplied
Fifield, Richard G.

MOBRIDGE

U. S. Army Corps of Engrs.
*Felde, Stuart R.

PRINGLE

Black Hills Lime Co.
Kirk, Samuel A.

RAPID CITY

Kirkham Michael & Assoc.
Reed, Donald Lee
So. Dak. School of Mines
*Gries, John Paul
*Lingard, A. L.
*McHugh, Alexander E.
*Oshier, Edwin H.
Partlo, F. L.
*Rapp, George R., Jr.
*Stevens, E. H.
*Tullia, Edward L.
*Weisz, Herbert M.
So. Dak. Min. Exp. Station
*Willigman, Melvin G.
U. S. Bureau of Mines
Kommers, Willis C.
*Ricketts, C. E.
Riley, James M.
No Data Supplied
Gardner, W. Frank
*Hall, Arthur Elwin
*Hayes, Joel P.
Hays, Robert D.
Hill, Robert S.
Mehle, Raymond J.
Ryan, John M.
Stotelmeyer, R.

SIOUX FALLS

Albert, Tom
Robertson, Thomas M.

STURGIS

Knapp, Edward, Jr.

VERMILLION

So. Dak. Geol. Survey
*Agnew, Allen F.
No Data Supplied
*Rothrock, Edgar P.

TENNESSEE

ALCOA

Harrison Const. Co.
*Sayrs, Richard L.

BRENTWOOD

Geologic Associates
*Throckmorton, R., Jr.

CHATTANOOGA

Aston Mineral Engrg. Co.
*Lee-Aston, R.
Heavy Minerals Co.
Kruel, Paul R.

COLUMBIA

Intern. Min. & Chem. Corp.
Richards, C. Lester
No Data Supplied
*Powell, James F.

CONCORD

No Data Supplied
*Thoenen, John R.

COPPERHILL

Tenn. Copper Co.
Clay, Roy G.
Goodman, James E.
Hengar, Herbert B.
Kingman, Owen
Lewis, F. M.
Longworth, F. J.
Schultz, John F.
Sharp, Samuel E.
Sorensen, Roy T.
Wagner, Delbert R.
Weaver, Lamar
No Data Supplied
Blair, James C.
Flournoy, Ezell
Ramsey, J. R.

DUCKTOWN

Tenn. Copper Co.
Annand, Albert D.
Gibson, Otis J.
Kendall, Hugh F.
Kopp, Guerdon G.
Magee, Maurice
Moore, Donald P.
Seaman, Clarence F.
No Data Supplied
Estabrooks, H. B.

ERWIN

Int. Minerals & Chem.
*Hunter, Charles E.

GLEASON

United Clay Mines Corp.
Lowe, Robert D.

JEFFERSON CITY

New Jersey Zinc Co.
Miller, Howard W.
Provost, John F.
Redeker, Immo H.
U. S. Steel Corp.
Miller, Joseph A.
Wilson, Robert T.
No Data Supplied
*Brophy, Frank B.
*Jennings, Edward B.

JOHNSON CITY

No Data Supplied
Bailey, Benton B.
DeBeck, Hubert O.

KINGSPORT

No Data Supplied
Evans, T. B.

KNOXVILLE

American Limestone Co.
Sansom, Richard E.
American Smelting & Ref. Co.
Kent, Deane F.
Electro Manganese
Forbes, D. O.
Gardner-Deuver
Franz, George A.
Ingersoll Rand Co.
Cleveland, James K.
Flynn, A. L.
MacDuff, Richard D.
Joy Mfg. Co.
Bergman, C. W.
Waddock, F. B., Jr.

Pennsylvania-Tennessee

Sanford-Day Iron Works
*Durk, Robert R.
Jones, Robert Edward
Moreman, Wm. D.
Williams, Cyrd H.
Southern Coal & Coke Co. Inc.
Pratt, E. Hahan
Univ. of Tennessee
Cummings, David
Westerdahl, Allen F.
TVA
Barker, C. T.
U. S. Bureau of Mines
Lynch, Victor J.
Valley, James L.
U. S. Geological Survey
Laurence, Robert A.
Lesure, Frank G.
Volunteer Port. Cement Co.
Bozeman, James A.
No Data Supplied
Howie, Howard
Jenkins, D.
Pasco, Edwin E.
Younger, J. J.

LAUREL BLOOMERY

Laurel Bloomy Mnes
*Flintermann, E. D.

MASCOT

American Zinc Co. of Tenn.
Black, William
*Brittain, R. L.
*Bumgarner, J. G.
Coy, Harley A.
Langley, M. J.
Miller, Harry L.
Oder, Charles R. L.
*Polhemus, James H.
Ricketts, James E.
Stickney, W. F.
No Data Supplied
Siak, Connie, Jr.

MEMPHIS

Buckman Labs. Inc.
Miller, Roger N.
U. S. Air Force
Nelson, Carl J.
No Data Supplied
*Estes, Frank M.

MONTEREY

Clinchfield Coal Co.
Wright, E. F., Jr.

MORRISTOWN

No Data Supplied
Hill, William T.
Spears, John W.

MT. PLEASANT

Virginia-Carolina Chem. Corp.
Girardeau, Malcolm D.
Grisom, Roy J.
Keller, Leonard J.
*Langa, Stephen F.
No Data Supplied
*Barr, James A.
Sullivan, Jay Neal
Sullivan, Wm. L.

NASHVILLE

Tenn. Prod. & Chem. Corp.
Kelley, J. C., Jr.
*Farlin, Carl, Sr.
McFarlin, Carl, Jr.
Vanderbilt Univ.
*Jewell, W. B.
Victor Chem. Wks.
Zergiebel, C. P.

NORRIS

No Data Supplied
Miller, Virgil

OAK RIDGE

Union Carbide Nuclear Co.
Sanders, Orby Ray

OLIVER SPRINGS

No Data Supplied
Shattuck, T. N.

PARIS

H. C. Spinks Clay Co. Inc.
Carothers, Richard Butler

ROBBINS

Scott Coal Co.
*Gallagher, H. M.

Tennessee-Texas

SEWANEE

Sewanee Silica Co.
Edwards, Paul K.

SWEETWATER

National Lead Co., Baroid Div.
*Keim, John T.
Sturgeon, David A.

TREADWAY

The N.J. Zinc Co.
Bernholdt, Arthur G., Jr.
Kyhkynen, Pentti W.
*Mills, Paul J.
*Morrin, Wilbur J.
Nelson, Jack E.
*Ziminski, Richard W.
No Data Supplied
Craig, James I.

TEXAS

ABILENE

No Data Supplied
Perini, V. C., Jr.

ALICE

No Data Supplied
Edmondson, Bryon P.
Kline, L. E., Jr.

ALPINE

Teplangua Mercury Corp.
Fulliam, R. N.

AUSTIN

Comstock Oil Co.
*Copeland Thomas A.
Reed & Brewer
*Reed, C. B.
Twin Star Ind. Inc.
*McNabb, John S., Jr.
U. of Texas
*Bucknall, Eric H.
*Flawn, Peter T.
*Lonsdale, John T.
No Data Supplied
Hill, Harry P.

BELLARE

Texas Co.
Herzog, Gerhard
Pancake, Evan
No Data Supplied
Arrowsmith, M. R.
*Malherbe, G. J.
McKinlay, P. F.

BLANKET

No Data Supplied
Ryan, D. P.

BRIGHAM CITY

Thiokoh Chem. Corp.
Weatherston, Vern H.

BROWNSVILLE

No Data Supplied
Nye, S. Spencer

BURNET

Southwestern Graphite Co.
Miller, Robert P., Jr.

COMANCHE

No Data Supplied
Hatchett, S. P.

CORPUS CHRISTI

Reynolds Metals Co.
Sherwin, Ralph S.
No Data Supplied
Hammer, William L.
Michael, Edwin B.
Facchetti, F. A.

DALLAS

Atlas Land Co.
Moran, Chas. Gill
Century Corp.
Spencer, Morris G.
Delhi-Taylor Oil Corp.
Norman, Larry L.
Soltes, Dr. Elton D.
Dixie Lead Co.
Bradfield, C. B.
Dorr-Oliver Inc.
Porter Ed. F.
Dresser Indust. Inc.
Lawrence, John

Geophysical Service Inc.
Saunders, Donald F.
Thomas, J. W.
Geotechnical Corp.
*Heroy, William B.
GSI

Montgomery, Lindell E.
Halliburton Oil Well Contg. Co.
Wimberly, Chester L.
Hammermills Inc.

KRAGE, AUGUST P.

Koch & Fowler & Grofe Inc.

*Dallas, Orlian L.

Lynn I. Northrup Jr.

Petuch, B.

Magnolia Pet. Co.

Jennings, Philip H.

Pollard, T. A.

Smallwood & Son Oil & Gas

Smallwood, Joe L.

Society of Petroleum Engrs.

of AIME

Bratt, Maurice D.

Southern Lead Co.

Murph, D. B.

Texas Power & Lt. Co.

*Barr, James A., Jr.

Titanium Metals Corp.

*Kane, Robert L.

Tripp Res. Corp.

*Tripp, R. Maurice

U.S. Army

*Murchison, John W., Jr.

Walters Drilling Co. Inc.

Dressner, Elliott F.

No Data Supplied

Bostick, J. W.

Keating, Thomas W.

Kopanski, Ronald P.

Noyes, Jonathan A.

Woods, Charles J.

DONNA

No Data Supplied

Edwin, C. H.

*Edwin, John

DUNDEE

No Data Supplied

*Moseley, Cecil R.

EAGLE PASS

No Data Supplied

Olitz, Ernest G.

EL PASO

Allis Chalmers Mfg. Co.

Despina, J. E.

Amer. Smelt & Ref. Co.

Clendenia, Thomas P.

Deckrow, Theon R., Jr.

Godsey, Edwin S.

Horle, Ariel F.

Johnson, Stanley W.

Kendall, Francis P.

Mahoney, William R.

McGeorge, R. M.

Mellen, Romney J.

Morton, N. A.

Nock, W. J.

Urquhart, James G.

Vogt, Thomas L.

Whitton, Warren W.

Darbyshire Steel Co.

Darbyshire, M. S.

Dickinson Labs Inc.

Ruotsala, Albert P.
Stricklin, Wm. D.
*Thomas, Eugene M.
Westinghouse Elec. Corp.
Lind, Theo. R.

Lowe, John W.

Worthington Corp.

Akers, Perry A.

Dawson, W. E.

No Data Supplied

Bradish, Ames D.

Bartlett, Wm. T., Jr.

Benedict, Edwin A.

Bevan, Horace D.

Brady, G. T.

Brooks, John M., Jr.

Buescher, Louis

Cansles, Frank J.

Carlisle, L. Reid

Chamness, Jim

Deisler, Paul F.

*Dempsey, J. F.

*Dickinson, Robert G.

Dismant, John H.

Foster, Hallard W.

Fox, Fred L.

*Fuentes, C. A.

*Garbrecht, Louis

Garcia-Loera, Raymond G.

Goss, Eugene R.

Graham, John F.

*Jordan, C. F., Jr.

Kennedy, Bruce W.

Klutts, Joe R.

Luckett, Joseph S.

Manahan, R. F.

Maxwell, J. Worth

McKay, Glover S.

Melancon, T. S.

Miller, Earl E.

Nash, Billy F.

Navarette, C. A.

Ponsford, R. G., Jr.

*Pyburn, Paul F.

Rogers, Jon W.

Rule, Chas.

Schumacher, W. P.

Steger, Paul A.

*Visel, C. E.

Weiner, Rudolph S.

Wilbina, Richard G.

Winslow, D. P.

FORT BLISS

U.S. Army

Roberts, David

Voelzel, Gustave W.

FORT HOOD

U.S. Army

Turner, John H.

Canady, Donald W.

FORT WORTH

Chicago Pneum. Tool Co.

Ferguson, John P.

Mathes Co.

Devin, William B.

Southern Geophysical Co.

Harris, Sidon

No Data Supplied

*Dukes, Wm. F.

Hein, V. N.

*McCart, Robert, Jr.

Wagner, Earl

FREEPORT

Dow Chemical Co.

Krenzke, Fred J.

Lentz, Rolf H. K.

Levinson, Alfred A.

McAnulty, William N.

Freeport Sulphur

Vincent, D. D.

GLADWATER

No Data Supplied

Jehson, Charles H.

GRAHAM

New Idria Mining & Chemical Co.

Goring, Arthur W.

HURRICANE

Coleman Engrg. Co.

*Poehlmann, Edwin J.

HILLSBORO

No Data Supplied

*Hawkins, T. Gaines

HOUSTON

Aluma

Werner, James E.

Armco Steel

Lloyd, C. Leonard

Austral Oil Co.
Mochlman, Robert S.
Brown Geophys. Co.
*Brown, Hart
Brown & Root Inc.

Brown, George R.

Cameron Iron Works Inc.

Allen, Herbert

Campbell Fertilizer Co. Inc.

*Davis, John M.

Chavigny Co.

Chavigny, Neil L.

Continental Oil Co.

Reynolds, Jack J.

Dow Chem. Co.

Foxhall, Harold B.

Duval Sulph. & Potash Co.

Morris, William Page

Freeport Sulphur Co.

Johnston, Robert H.

Gravity Meter Expl. Co.

*Sobel, Harvey L.

Gulf Sulphur Co.

Bellano, William

Hughes Tool Co.

Martin, Daniel J.

Williamson, Thomas N.

Wirtz, Howard A.

Humble Oil & Ref. Co.

Taylor, Ralph E.

Link Belt Co.

Henry, R. R.

Hoch, Thornley

Magehar

Brown, Enoch A., Jr.

Metcalfe, H. S. K.

Magnet Cove Barium Corp.

*Talbot, C. F.

Van Dyke, Orlan

Milwhite Mud Sales Co.

*Freeman, William G.

Mission Mfg. Co.

King, Morton C.

Nat. Lead Co.

Baker, Lynn Maurice

Chaney, Jas. B.

Elsley, B. C.

Murphy, James P.

*Pushkin, D. B.

Rowand, Reginald

*Wallace, John Bruce

Williams, Don E.

Robert H. Ray Co.

Ray, Robert H.

Rogers Geophy. Co.

Outcalt, E. E.

*Rogers, Sam D.

Ruska Instrument Corp.

*Ruska, Walter E. A.

Salt Dome Production Co.

McQueen, H. S.

Schlumberger Well Surv. Corp.

Leonardon, Eugene G.

Shell Oil Co.

Levine, Joseph S.

*Robertson, Glenn D.

Sinclair Oil & Gas Co.

Alewine, James W.

Texas Gulf Sulphur Co.

Ogg, James H.

Wolf, Albert G.

Texowell Service & Mach. Co.

Bayle, Pierre

No Data Supplied

*Bell, Olin G.

Berube, S. C.

Breland, Rufus A.

Cashin, D'Arcy M.

Hundley, Ovid B.

Kawas, Jesus B.

McCart, W. B., Jr.

*McEvoy, Joseph H.

Mewhirter, S. A.

Penrose, R. J.

Pollard, J. C.

Prince, R. W.

*Schoenike, Howard G.

Steenland, Nelson C.

*Thomas, Conrad Ward

Webb, Harry C.

HURST

Heart of Texas Ming. Co.

SAN MARCES

No Data Supplied
*Pollard, J. H.

TEMPLE

No Data Supplied
Chippendale, Arthur

TEXAS CITY

Smith-Douglas
Johnson, B. W.
Wah Chang Corp.
Mackey, Thomas Stephen

VICTORIA

No Data Supplied
Atherton, W. S.

WACO

No Data Supplied
Nelson, Schuler

WICHITA FALLS

W. H. Hammon
Darnier, Richard R.

YSLETA

No Data Supplied
Pendell, Geo. W.

UTAH

AMERICAN FORK

No Data Supplied
Crandall, L. Dee

BINGHAM CANYON

Kennecott Copper Corp.
Anderson, W. R.
Carlson, Thomas R.
Davis, Kenneth L.
Grant, Edward S.
James, Allan Harris
*Helm, John E.
Jager, Alan R.
*Kerr, Dean D.
Norden, Joseph A., Jr.
*Smith, Wilbur H.
Snow, Laurence E.
*White, Merwin G.
No Data Supplied
Gough, Ray F.
Johnson, C. L.
Kastelic, Albert
McKellar, J. L.
Rauer, Richard C.
Simkins, Ernest C.
Steele, Richard G.

BLANDING

Newmont Exploration Ltd.
*Kehoe, Charles A.

BONANZA

American Gilsonite
Dewey, Richard F.
*Diskin, Jack S.
No Data Supplied
Borden, Paul

BOUNTIFUL

No Data Supplied
Johnson, H. A.
Kuhn, W. C.
Olin, John R.
Quigley, W. D.
Terry, Dale O.

BRIGHAM CITY

No Data Supplied
Carliquist, Stephen

CEDAR CITY

Colo. Fuel & Iron Corp.
Norstrom, Chester F., Jr.
Robertson, John, Jr.
Columbia Iron Mining Co.
Bunnell, Wendell Lee
Glas, Vernon
Hahne, Edward H.
*Heyborne, Lester S.
Loer, Robert F.
Lunt, H. Douglas
Quinn, John D.
Tompkins, F. Vernon
Whitney, I. Gordon
Utah Construction Co.
Bellum, Donald P.
DeMoss, E. C.

No Data Supplied
Evans, Howard
Galbraith, F. M.
Heaton, Norman
Lott, Ivan L.
McDonald, G. D.
McMullin, G. K.
Melin, Robert E.
Middleton, Doug W.
Milne, H. D.
Urie, Roy F.
Wilkinson, Lex P.

DEVILS SLIDE

Ideal Cement Co.
Burriss, Chas. S.

DRAGERTON

Columbia-Geneva Steel Div.,
U.S. Steel
Bowen, R. J.
Cassano, James
von Storch, R. M.
Yourston, Robert E.
No Data Supplied
Hammerstrom, R. B.
McKean, J. B.
Paternell, F. J.

EUREKA

Bear Creek Mining Co.
Bush, John B.
Howd, Frank H.
Centennial Develop. Co.
*McIntyre, E. Steele
Quigley, James
*Spencer, Harold B.
Watt, Robert E.
Chief Const. Min. Co.
Fitch, Cecil
*Fitch, Cecil A., Jr.
No Data Supplied
Thomas, Robert C.

GARFIELD

Calera Mining Co.
Commel, Carl F.
Kennecott Copper Corp.
Deneris, George
Parks, S. O.

GREENRIVER

No Data Supplied
Huntsman, Scott D.

HEBER

United Park City Mines
Barnes, Marvin P.
*De La Mare, G. W.
Gray, Arthur W.

HIAWATHA

U.S. Fuel Co.
*Rasmussen, Arvid Brandt
No Data Supplied
Coulson, James W.
Jackson, T. C.

HOLLADAY

No Data Supplied
Cromar, R. E.
Dwyer, Ed T.

KENILWORTH

Independent Coal & Coke Co.
Jackson, E. O.

LARK

U.S. Smelt. Ref. & Min. Co.
Barrett, Soren A.
Boyd, Benton
Coffey, James A.
Holmes, John W.
Hunter, Edgar T.
Lowell, Gerald F.
Wells, Harold H.
Willie, Don O.
No Data Supplied
Buchler, J. Kent
Denton, Pedro
Fresh, Neil
Gillam, Clyde W.
Hall, Harry D.
Nealley, Roy D.
Partner, Richard W.
Rubright, R. D.
Serasio, Bert, Jr.
Sheldon, Wright C.
Tibolla, Joseph
Whitmore, Alton L.
Wojcik, J. R.

LA SAL

No Data Supplied
Nash, Alvin E., Jr.

LOGAN

Utah State Univ.
*Olsen, Donald R.
No Data Supplied
Spindler, James L.

MAGNA

Kennecott Copper Corp.
Barker, Thomas, Jr.
Ensign, H. A.
Ensign, Peter H.
Plummer, Neil
Quigley, Charles G.
Ribotto, Joe W.
Richardson, J. W.
Walje, J. Richard
No Data Supplied
Beck, Clyde
Hubbard, Thomas J.

MANTI

No Data Supplied
Parry, Wm. T.

MEXICAN HAT

Texas-Zinc Minerals Corp.
Wakefield, Roger E.
Apland, Kenneth C.
No Data Supplied
Larsen, William T.
Von Collin, H.

MIDVALE

Amco Steel Inc., Ross-Cowan
Equip. Co.
*Ross, Albin M.
U.S. Smelt. Ref. & Min. Co.
Berghout, Richard
Creglow, Loran A.
Gillaspie, K. B.
Nelson, A. A.
Stampfel, Frank J.
No Data Supplied
Barlow, V. S.
Elder, Lloyd S.
Gray, Vernon L.
Hartvigsen, L. M.
Johnson, R. D.
Nemi, John O.
Pezel, Paul S.
Smith, Simeon W.
Wanlass, Ralph

MOAB

Delhi-Taylor Oil Corp.
Norman, Robert R.
Geological Services
*McDougal, Wm. Dean
Hecia Mining Co.
Greenslade, James O.
Lindstrom, Philip
Hidden Splendor Mining Co.
Loring, W. B.
Mullen, John R.
Newman, Joseph Melvin
Rich, Eugene E.
Shelfelbine, G. H.
Wood, Edwin T.
Homestake Mining Co.
Weid, Walter W.
Jacobson, Edward F., Jr.
Miner, Gordon M.
Jen, Inc.
Craig, Samuel E.
*Moore, Lyman
Libson Uranium Corp.
Blakely, Harold W.
Standard Uranium Corp.
Bruchner, Gordon W.
*Hurst, Robert M.
Wood, Russell L.
Uranium Ref. Co.
Falconer, Robert A.
*Hollis, R. F.
*Izzo, T. F.
*McCormick, R. E.
Poppe, D. C.
Ranspot, Henry W.
Rowe, Carl H.
Smith, Rupert M.
Stocks, Gerald
Unger, R. W.
Utex Exploration
Ball, Lauren L.
Barrett, Theodore J.
Lye, Virgil B.
*Gonzalez, Alexander E.
Pierson, Max D.
Steen, Charles A.
No Data Supplied
Bellenir, T. E.
Decker, G. F.
Florence, H. S., Jr.
Franklin, William J.
Mayhew, Eldon J.
McLellan, R. R.
Nugent, Claude E.
Poller, Harry S.
Reynolds, Richard C.
Walker, Glen

MONTICELLO

National Lead Co. Inc.
Bailey, John E.
*Coates, George K.
*Dickerman, Edward Day
Palmer, Jerald

MURRAY

Minerals Ref. Co.
Trover, W. Morris
Murray Refractories Co.
Stevens, Joseph E.
Utah Ore Sampling Co.
Jensen, E. G.
No Data Supplied
Beck, Russell R.

OGDEN

No Data Supplied
Fay, Herbert M.
Hett, Paul
Pike, Julian A.

OREM

Kennecott Copper Corp.
Solomon, James D.
No Data Supplied
Peper, R. K.
Sigman, V. L.

PARK CITY

New Park Min. Co.
Bauer, Walter E.
Utah Minerals Co.
*Costas, Tom P.
No Data Supplied
Amnes, E. C., Jr.
Archer, Bob F.
Kuhlman, F. A.
Stewart, H. V.

PAYSON

No Data Supplied
Johnson, Raymond C.
Pett, Ray W.

PRICE

No Data Supplied
Kennedy, Richard R.
Watkins, G. R.

PROVO

Brigham Young Univ.
*Bullock, Dr. Kenneth C.
Columbia Oron Min. Co.
Camp, Leslie W.
Chapman, Rodger H.
Godbe, Murray Charles, III
Hayes, John E.
Mark, Clifford A.
*Reiff, John J.
Sekieman, Robert
No Data Supplied
Bickford, K. F.
Standiford, G. B.

SALT LAKE CITY

American Cyanamid Co.
Brown-Otto, R.
American Gilsonite Co.
*Baker, John H.
Goodner, E. F.
Henderson, John H., Jr.
Amer. Smelt. & Ref. Co.
Anderson, B.
Bowditch, Samuel I.
Di Santo, B. J.
Frost, J. F.
Hewitt, William F.
Houghton, G. K.
Lacy, Robert J.
Ness, Arnold W.
Newman, Earnest W.
Tainter, Stanton L.
Troxell, R. C.
Vincent, J. D.
Weiss, Norman L.
Amer. Zinc, Lead & Smelt. Co.
Mills, Hiram F.
Anaconda Co.
Dwyer, Robert G.
Garmoe, Walter J.
Hansen, Leon A.
*Humphrey, Arthur G.
Kildale, Malcolm B.
Mulchay, Roland B.
*Parker, Florence D.
*Seymour, Winton L.
*Thompson, Mercer F.
Waterman, Glenn C.
Amco Steel Corp.
Bailey, Frank E.
Atomic Energy Comm.
*Peterson, Wilmer R.
Bay Shore Mining Co.
*Davis, Dudley L.
Bear Creek Mining Co.
Burgess, C. H.
Cook, Douglas R.
Jerome, S. E.
Walthier, Thomas N.
Weiss, Alfred

Black & Deason
Deason, B. W.
Bonneville Leds.
*Ferris, Lockwood W.
Book Cliffs Coal Co.
*O'Connor, Edward S.
Booth Co. Inc.
Booth, L. E.
Boyies Bros. Drilling Co.
*Gillingham, W. P.
*Goldsworthy, R. T.
Robins, N. K.
Sainsbury, Ferris E.
Bush Engrg. & Mfg. Co.
*Bush, Giles F.
Cate Equip. Co.
Moore, William C.
Chain Belt Co.
*Petrie, P. B.
Chicago Bridge & Iron Co.
Schultz, Jack W.
Christensen Diamond
Products Co.
Harris, William I.
Miles, Ned
J. J. Coan Co.
Coan, B. G.
Colorado Fuel & Iron Corp.
Bole, J. A.
Combined Metals Red. Co.
Gemmil, Paul
Snyder, Edward Harrison
*Young, Earl B.
Comm. Shear & Stamping Co.
*McBride, Carl L. R.
Kinco Corp.
*Bernard, L. D.
Kipp, Erwald
Kirschner, Ernesto J.
Patel, Bhaskar T.
*Ross, Neil L.
Saunders, David W.
*Thompson, Robert B.
Federal Uranium Corp.
*Messery, Lee R.
Foley Bros. Inc.
*Bares, L. J. "Ted"
Galagher Co.
Evans, S. L.
Huch, Richard O.
Kantarti, W. A.
*Lange, Lawrence H.
Sandberg, I. L.
*Wright, Harold E.
Gardner Denver Co.
Jarvis, O. G.
General Conveyor Inc.
*Lippert, W. J.
General Electric Co.
Battley, Elmer C.
Hohmann, H. E.
General Petroleum Corp.
Witter, George G., Jr.
Gibbons & Reed Co.
Gibbons, J. P.
Golden Cycle Corp.
*Hansen, Max W.
Hale Mines Inc.
Callaghan, E.
Heiner Coal Co.
*Heiner, C. F.
Westberg, C. S.
Hercules Powder Co.
Early, L. W.
Hearon, Henry Hooper
Hoogstraet, Bernard L.
*Spari, Charles R.
Hewitt-Robins Inc.
Allison, Bill
Van Stone, James E.
Hidden Splendor Min. Co.
Edwards, Albert P.
Fowler, Shannon A.
*Hayes, Dale I.
Kibbe, A. P.
*Nobs, Ken
Howe Sound Co.
Kirkland, Arch G.
Smith, Harold B.
Independent Coal & Coke Co.
*Dyer, Bert W.
Industrial Physics &
Electronics Co.
*Marquardt, C. M.
Ingersoll-Rand Co.
Foster, Rodney C.
Lawson, Robert W.
Merritt, Joseph B.
Intl. Smelting & Refining Co.
Burt, Glen A.
J. T. Jenkins Co.
*Kasper, Mark T.
Joy Mfg. Co.
Lee, Fred L.
Swiler, William R.
Joy & Cox Inc.
Bunch, Carl M.
Kennecott Copper Corp.
Baldeo, L.
*Bogden, Errey
Boyer, Philip J.
Burt, Wayne H.
Clark, Robert Bucknam
Engelmann, E. W.
*Erickson, John Duff
Fraser, George L.
Fuller, Thomas R.
Green, Frederick C.

Utah-Virginia

Houston, D. C.
Landenberger, J. C., Jr.
Lentz, Bruce A.
Lyon, R. J. P.
Michaelson, C. D.
Michaelson, S. D.
Mott, Clinton P.
Newman, Elmer C.
O'Keefe, John P.
Olson, Emmett K., Jr.
Pett, L. Fern
Slothower, Ben H.
Smith, Francis J.
Soderberg, Adolph
Stewart, Richard L.
Thompson, C. Sheldon
Thuli, A. J., Jr.
Tibbie, Ralph J.
Wood, Lewis C.
York, William B.
Zimmerley, S. R.
E. J. Longyear Co.
Doolin, James J.
Lottridge-Thomas & Assoc.
*Lottridge, Richard W.
*Thomas, Leonard G.
Machinery Center Inc.
Curry, David H.
*Davis, Logan E.
Uzelac, Joe G.
Mallinckrodt & Mallinckrodt
*Mallinckrodt, Philip A.
Marvel Mining Co.
*Harrison, Duncan E.
Mine Safety Appliances Co.
Allen, Earl W.
McElhattan, D. F.
Minerac Corp.
*Banta, Royden J.
Morton Salt
Clayton, Norman
Mt. States Rubber Co. Inc.
Reese, D. W.
Natl. Equipment Co.
Causton, Wilford S.
Merry, Henry M.
Natl. Filter Media Corp.
*Haedt, Robert V.
New Park Mining Co.
Cranmer, W. H. H.
*Hansen, Carl A.
*Wilson, Clark L.
Park City Cons. Mines Co.
*Stehle, Frederick T.
Peterson Filters & Engrg. Co.
Mattison, Robert J., Jr.
Radium King Mines Inc.
*Flint, Arthur E.
Rare Metals Corp. of Amer.
Hansen, Leland A.
Kline, Mitchell H.
McKinney, Allen A.
Snider, James J.
Rico Argentine Min. Co.
Hinckley, Sherman B.
St. Regis Paper Co.
Willett, Alfred A.
Senior & Senior
Senior, Clair M.
Shaft & Dev. Machines Inc.
O'Leary, Paul C.
Shell Oil Co.
Woodward, Warren M.
Shenon & Full
*Full, Roy P.
*Payne, Anthony L.
*Shenon, Philip J.
Silver King Coalition Mines
Heitzman, Mearle G.
Silverado Mining Co.
Harrison, Thomas R.
Sunshine Mining Co.
Eddy, Ernest E.
Techniman Corp.
*Dawson, Harmel A.
*Pormoon, D. E.
*Snyder, Edward H., Jr.
Tintie Standard Min. Co.
Paine, M. D.
F. C. Torkelson Co.
*Huff, Ira S.
*Torkelson, F. C.
W. S. Tyler Co.
*Peterson, J. L.
Umont Mining Inc.
Wheeler, Dooley R., Jr.
Union Assay Office Inc.
Sadler, J. V.
United Park City Mines Co.
Droubay, Seth K.
*Stoner, John Wm.
U. S. Atomic Energy Comm.
Bales, William E.
U. S. Bur. of Land Mgmt.
Koch, Walter H.
U. S. Bureau of Mines
Brown, Joseph F.
Clemmer, J. Bruce
Dow, Vernon T.
Everett, F. D.
*Howes, Merwin H.
Naus, L. L.
Nichols, Ivan L.
Wilson, Stephen R.
*Young, William E.
U. S. Fuel Co.
Cornelius, Clinton C.

U. S. Smelt. Ref. & Min. Co.
Ashurkoff, Boris
Barber, C. J.
Billings, Thomas P.
Conrow, John M.
*DuBois, Max M.
*Ehrhorn, Jack M.
Gerwels, Richard P.
Glaeser, Oscar A.
Henline, Cloyd H.
Hilton, Chas. C.
Weagel, Robert C.
Uranium Reduction Co.
*Burgess, J. Wesley
Lesse, John W., Jr.
Utah Construction Co.
Goldstein, Norman Edward
Westphal, W. H.
Utah Mining Association
Horne, Walter M.
Mackenzie, A. G.
Romney, Miles P.
Utah Power & Light Co.
Mulcock, Wayne F.
Utah Sprocket & Mach. Co. Inc.
*Barkley, Bill F.
Univ. of Utah
*Cone, J. H.
*Cook, Kenneth L.
*Eandley, Armand J.
Meyerth, Frederic H.
Nackowski, M. P.
*Stringham, Bronson
*Wadsworth, Milton E.
*Whelan, James A.
H. J. VanderVeer & Assoc.
*VanderVeer, H. J.
Vitro Corp.
*Cook, Charles C.
Ellis, Martell
Moore, James D.
*Price, Michael A.
Smith, Cecil H.
*Schiff, Norman N.
Snyder, David M.
Young, Gavin H.
Western Machinery Co.
*Starr, Robert P.
Western Rock Bit Mfg. Co.
Siegel, Horace U.
Western States Oil & Metals Co.
*Lyon, Paul C., Jr.
Westinghouse Electric Corp.
Hodgins, H. B.
Jones, J. N.
Weyher Const. Co.
Weyher, Robert F.
Wilson Exploration Co.
*Wilson, Clyde H.
Worthington Corp.
Wilson, Paul E.
No Data Supplied
Adair, Donald H.
Alderman, S. S., Jr.
Aldous, T. Melvin
Anderson, C. M.
Anderson, Donald O.
Anderson, E. L.
Anderson, Royal P.
Andrus, Niles J.
Archer, Thomas J.
Arentz, S. S., Jr.
Augustson, A. E.
Austin, Charles L.
Bader, John W.
Bauer, B. A.
Beckstead, Rex C.
Beeson, J. J.
Blessing, Ernest
Boutwell, John M.
Brady, William T.
*Breckon, L. S.
Brennan, James T.
Brewer, Quentin L.
Buehler, F. L.
Burwell, Blair T.
*Chaffin, C. E.
*Christensen, A. Lee
Christensen, Carl H.
Christensen, N. S.
Christiansen, F. W.
Clark, Wm. B.
*Clarke, Roger W.
Clemens, George L.
Clitherose, Jay B.
Coleman, Robert B.
Cox, Fred E.
Crane, Gary F.
Cropper, K. F.
Cunard, Frederic G.
Damsie, Lynn W.
Deane, M. Sheila
Droste, Keith J.
Fagan, Paul F.
Earl, George C.
Egan, Wm. J.
Eggleston, Marvin P.
Elders, K. Fritz
Erwin, John W.
Felgenhauer, H. I.
Flatburg, Orrison M.
Friendly, O. N.
Gardner, J. R.
Gibson, Edgar G.

Goldsworthy, A. F.
Goodell, Ralph E.
Granger, Arthur E.
Griffith, W. A.
Crisley, Robert J.
Guard, Alton K.
Gunnell, Farrell
Haddon, E. D.
*Hall, Newton L.
Hanna, Ernest V.
Hansen, Robert M.
Hansen, Walter R.
*Hanson, Frederick W.
Hart, U. H.
Hawkesworth, M. W.
Hays, Larry J.
Hearn, Jane K.
Heiner, K. P.
Herres, Otto
Hersey, Lewis G.
Hewitt, Grant J.
*Hood, K. K.
Hopkins, John B.
*Horton, Jack O.
Huffman, Clyde S.
Hughes, David E.
*Hunt, Richard N.
Ivers, J.
Ivers, James, Jr.
Iverson, Melvin D.
*Jenike, Andrew W.
Jimenez, R. A.
*Johnson, Earl S.
*Johnson, J. Fred
Johnson, Raymond A.
Jones, L. C.
Kastelic, A. R.
Kintzinger, W. H.
Kittle, Percy H.
Knudsen, John F.
Knudsen, Chas. B.
Lacher, Karl K.
Lamborn, R. Park, Jr.
Larson, John C.
Last, Arthur W.
Mabee, Douglas R.
Mallory, Roy E.
Matheson, K. H., Jr.
McFarlane, Ray
*Miller, Roswell, III
Moffat, A. D.
Moffat, David D.
Moore, Edward J.
Nault, W. J.
Nepper, John P.
Newsome, Don W.
Neyman, R. W.
Norris, Robert E.
O'Donnell, J. C.
*Oldright, G. L.
O'Neal, Thomas H.
*Ong, J. N.
Overfield, C. P.
*Osterstock, R. W.
*Pallanch, Rollin A.
Parker, Robert L.
Passavant, C. R., Jr.
Pehrson, F. L.
*Pierce, Roger V.
*Pinger, Allen W.
Portness, Robt. R.
*Price, John
Rains, Phillip K.
Ray, Otto A.
Reading, Keith E.
*Requa, L. K.
Reynolds, J. R.
Robertson, Daniel
Root, Robert L.
Rosenblatt, Joseph
Ruddock, Merritt K.
Sackett, Blair L.
Scholl, Lester K.
Sharp, William
Sheldon, Churchill G.
*Shields, Paul L.
Sinclair, Carl W.
Sontum, Christian
Staats, Fred
Stevens, Victor L.
Tallon, John F.
Thomas, C. F.
Thornburg, C. L.
*Tuck, Ralph
Urquhardt, R. D.
*Van Evers, DeWitt
Van Wagoner, Theo. R.
*Walker, Harlan A.
Wardlaw, Frank A., Jr.
Wetzel, N. F.
Williams, Robert I.
Williamson, R. M.
Wissmar, Monroe C.
Wormald, Bruce
*Wright, Theodore R.

SANDY
No Data Supplied
Haug, L. J.
Hewitt, Loyd A.
SPRING CANYON
No Data Supplied
Pauley, C. E.

ST. GEORGE

Western Gold & Uranium
*Richards, Russell L.
Winterhalter, E. C.
Wyman, Richard V.

SUNNYSIDE

Kaiser Steel Corp.
Dodds, Arnot W.
Peperakis, John
Wright, Wilmer C.
No Data Supplied
Hyatt, Vincent
Taylor, Joe T.
Turner, Stephen F.

TOOELE

Anaconda Co.
Ryan, George S.
Intl. Smelt. & Ref. Co.
House, O. E.
McKenna, W. U.
Saylor, T. W.
Steinbach, Emile W.
McFarland & Hullinger
Ashlock, Robert H.
Hullinger, S. R.
Utah Calcium Products Co.
Townsend, Byron E.
Utah Salt Co.
*ApRoberts, C. E.
No Data Supplied
Broxholme, R. L.
Kostello, George V.

WELLINGTON

Columbia-Geneva Steel Div.
McMorris, Wm. L., III
Knight Ideal Coal Co.
*Carlson, C. Arthur

WOODS CROSS

No Data Supplied
Higgs, Horace H.

VERMONT

BARRE

Rock of Ages Corp.
Ferris, Cyrus V., Jr.
Frost, Robert A.
Gillette, Robert S.

BELLOWS FALLS

Foot Mineral Co.
Kneass, George B., Jr.

BRISTOL

Vt. Kaolin Corp.
Mould, Willis Perry
Thurber, Richard B.

BURLINGTON

Eastern Magnesia Talc Co.
*Magnus, W. W.
Vermont Mining Inc.
Evans, Lewis P., Jr.

HYDE PARK

No Data Supplied
Bailey, Donald H.

NORWICH

No Data Supplied
*Dwelle, Richard C.

PROCTOR

No Data Supplied
Reissig, B. N.

SO. BARRE

No Data Supplied
Wall, F. F.

SOUTH STRAFFORD

Vermont Copper Co., Inc.
Cowley, J. F.
No Data Supplied
Benson, C. B.
Little, Richard H.

SPRINGFIELD

No Data Supplied
Leitch, G. G.

WATERBURY

No Data Supplied
Backels, Victor A.

VIRGINIA

ALEXANDRIA

No Data Supplied
Gowen, Justin B.
Gresseth, E. W.
Mackintosh, R. M.

ARLINGTON

No Data Supplied
Anderson, Geo. W.
Anderson, Robt. L.
Anderson, Walter C.
Bilharz, O. W.
Fruitman, F. W.
*Gardner, E. D.
Harrington, Daniel
*Holderer, George B.
Klinko, Robert C.
McMahon, A. D.
Scholla, Paul F.
Tully, C. W.

AUSTINVILLE

The New Jersey Zinc Co.
Albers, Walter L.
Brown, W. Horatio
Frankenfield, William D.
Hannan, William S., Jr.
Knutson, Ray M.
McNaughton, C. H., Jr.
Morgenstern, C. G.
Paulson, Walter H.
Tripucka, Paul
Winslow, Kenneth R.
No Data Supplied
Vannoy, J. L.

BATESVILLE

No Data Supplied
Reinhard, Fred P.

BEAVERDAM

No Data Supplied
Goin, Charles M.

BERRYVILLE

No Data Supplied
Williams, J. F., Jr.

BIG STONE GAP

General Coal Co.
Shupe, James N.
Stonaga Coke & Coal Co.
Jones, Wilmet C., Jr.
Meador, H. W., Sr.
Schott, W. C.
Smith, W. Clifford
Strang, E. N.

BLACKSBURG

Va. Polytechnic Inst.
Foreman, Wm. E.
Hamilton, Charles L.
*Holland, Charles T.
*Shelton, Carl, Jr.
No Data Supplied
Cooper, Byron N.

BRISTOL

Enterprise Wheel & Car Corp.
*Lahr, Robert W.

CAMP PICKETT

No Data Supplied
Harris, Ralph W.

CENTREVILLE

No Data Supplied
Stall, Chas. Meade

CHARLOTTESVILLE

Va. Div. of Min. Resources
Calver, James L.
No Data Supplied
Case, Albert H.
McGill, William M.

DANTE

Clinchfield Coal Co.
Corriveau, Martial P.
Hughes, Robert H.
Jostin, Richard E.
Morris, Francis M.
Stapleton, William A.
Sutherland, William H.

DELAPLANE

No Data Supplied
Tyssowski, John

DUFFIELD

Foot Mineral Co.
Cooke, Walter E.
Edwin, W. Dill, Jr.
Hudspeth, W. R., Jr.

FALLS CHURCH

No Data Supplied
Anthony, Micheal, V.
Brophy, James R., Jr.
McKnight, James R.
Mills, Charles S., Jr.

GAINESVILLE

No Data Supplied
Ristedt, E. J.

GALAX

Allied Chem. Corp.
Nichols, James O.
Yarberry, Arthur H.

GRUNDY

No Data Supplied
Hawkins, P.

HAMPTON

No Data Supplied
Martin, J. Dickerson
Phillips, P. B.

IVANHOE

No Data Supplied
Huddle, Chas. R.

KIMBALLTON

National Gypsum Co.
McDonald, Roderick G.

McLEAN

No Data Supplied
East, William F.

MARTINSVILLE

J. A. Gustin & Asso.
Gustin, J. A.

MIDDLEBURG

No Data Supplied
Wells, Thomas L.

MILLWOOD

No Data Supplied
Dunning, A. R.

NORTON

Coal Processing Corp.
Moroni, Eugene T.
U. S. Bureau of Mines
Gaddy Frank L.
Malesky, J. S.

OAKWOOD

No Data Supplied
Cox, Ralph H.

PINEY RIVER

American Cyanamid Co.
Craven, Carol E.
Rothschild, Stanley
Buffalo Mines, Inc.
Carroll, Daniel J.

FT. BELVOIR

No Data Supplied
Brand, Robert C.

PLASTERCO

U. S. Gypsum Co.
Decker, H. D.

POCAHONTAS

Peerless Coal & Coke Co.
Luther, Roland C.
Pocahontas Fuel Co.
Copeland, A. Eugene
Pero, John W.
Porterfield, Chas. W.
Skewes, William J.

QUANTICO

U. S. Marine Corps Base
Wainsley, Willis H., Jr.

RICHMOND

Ches. & Ohio R. R.
Ritchie, George G.

Lone Star Cement Corp.

Fritts, Stewart S.
Reynolds Metal Co.
Dreyer, Robert M.
Hollett, Grant T.
Michell, Wilson D.
Moorman, Henry D.
Moses, John H.

Southern Lightweight Aggregate Corp.

Roberts, John W.
Sydnor Pump & Well Co.
Hockman, Edwin L.
Virginia-Carolina Chem. Corp.
Heinrichs, C. E.
Richter, Roscoe
No Data Supplied
De Jarnette, J. C., IV

RIVERTON

Riverton Lime & Stone Co.
Holm, J. C.

ROANOKE

Norfolk & Western R. R.
Prosser, Fred K.
W. M. Ritter Lumber Co.
Ritter, William M.
Va. Iron, Coal & Coke Co.
Brown, Samuel T.

ST. CHARLES

Kem Gem, Inc.
Connelly, C. F.

SALTVILLE

Olin Mathieson Chem. Corp.
Rapp, H. Clinton
Weaver, R. S.
No Data Supplied
Harnsen, Lynn
Kebblish, Edward

STEPHENS CITY

M. J. Grove Lime Co.
Bass, Charles E.

STRASBURG

Chemstone Corp.
Falvey, Arthur E.

SUNBRIGHT

Foot Mineral Co.
McDonnell, A. J.

TAZEVELL

Jewell Ridge Coal Corp.
Alley, Marvin L.
Bagenstose, Raymond M.
Cothern, Leland T.
Kilgore, William D., Jr.

THE PLAINS

No Data Supplied
Crouse, L. F.

TIDEWATER

No Data Supplied
Bean, Louis H.

WISE

Thompson & Litton
Thompson, Wm. A., Jr.

WOODBIDGE

No Data Supplied
Barton, Wm. R., Jr.

WASHINGTON**AUBURN**

No Data Supplied
Lindberg, Russell A.

BELLEVUE

No Data Supplied
Didrichsen, W. G.
Strandberg, T. R.

BELLINGHAM

Baker & Ford Co.
Koropp, John G.

BOTHELL

No Data Supplied
Jones, Lyle P.

BREMERTON

No Data Supplied
Jacques, Neal M.
Strong, Ronald D.

BUCKLEY

Cameron A. Rich Assoc.
Rich, Cameron A.

BURIEEN

No Data Supplied
Langness, Oren O.

BURLINGTON

No Data Supplied
Romig, Woodfred E.

BURTON

No Data Supplied
Billingsley, Paul

CHELAN

No Data Supplied
Phillips, W. S.

CHEWELAN

N. W. Magnesite Co.
Endrice, Barney
Fisk, Roger L.
Ziebell, Howard A.
Lovejoy Min & Leas.
Lovejoy, Victor E.

CLARKSTON

No Data Supplied
Atkinson, S. K.

COLVILLE

Goldfields Cons. Mines Co.
Higginbotham, T.
No Data Supplied
Paparich, Frank H.

DAVENPORT

No Data Supplied
Thompson, V. N.

DISHMAN

No Data Supplied
Swann, Wm. H.

EDMONDS

No Data Supplied
Dutcher, Howard G.

EVERETT

Assoc. Sand & Gravel Co.
Melrose, J. W.
Mod. Home Builders Inc.
Gonnason, Walter L.

FORD

Dawn Min. Co.
Crowhurst, John J.
Stucker, Paul E.

FRIDAY HARBOR

No Data Supplied
Green, Stephen H.

LOPEZ

No Data Supplied
Banks, Robert T.

MERCER ISLAND

Haaland & Hoskins Assoc.
Haaland, Otto E.

METALINE FALLS

Amer. Zinc, Lead & Smelt.
Calhoun, William M.
Currie, John W.
Lampson, Richard J. J.
Shellenberger, F. H.
Underwood, D. A.
Lehigh Portland Cem. Co.
Clayton, Austin B.
Pend Oreille Mines & Met. Co.
Billings, L. G.
Crampton, Jack C.
Kinney, Lindsay M.
No Data Supplied
Anderson, Roy A.

MONROE

No Data Supplied
Knudsen, Arede

MOUNTLAKE TERRACE

No Data Supplied
Dixon, Roy W.
Patterson, Alex

MT. VERNON

No Data Supplied
Dolch, Edw. W.

OLYMPIA

Dept. of H'Ways
McLaughlin, T. W.
Wash. Div. Min. & Geol.
Bennett, W. A. G.
Hunting, Marshall T.
No Data Supplied
Fidler, Clarence H.

OYSTERVILLE

No Data Supplied
Thompson, Glenn L.

PALMER

Corps of Engrs. Seattle Dist.
Richards, John C.

PORT BLAKELEY

No Data Supplied
Allgaier, B. E.
Earling, Roy B.

PULLMAN

Wash. State Univ.
Jaekel, John A.
Kraus, Howard G.
Masson, Donald L.
McKague, H. Lawrence
No Data Supplied
Culver, Harold E.

PUYALLUP

No Data Supplied
Hammermeister, E. A.

RENTON

Gladding McBean & Co.
Clark, Ralph I.

REPUBLIC

Knob Hill Mines Inc.
Patterson, Allan R.
No Data Supplied
Houghland, Everett P.

RICHLAND

Gen. Elec. Co.
Bierschenk, William H.
Brown, Randall E.
Wick, O. J.
No Data Supplied
Brown, Donald J.

SEATTLE

Atlas Powder Co.
Easterly, Emmett G.
Boeing Airplane Co.
Clark, Richard W.
Cris, Richard S.
Davidson, Harold O.
Ferguson, Andrew J.
Penn, Sheldon H.
Richardson, K. W.
Tuttle, Margaret Parent
City of Seattle
Corp. Ernest L.
E. I. DuPont De Nemours & Co., Inc.
Anderson, A. E.
Hauser, Maximilian E.
Strobecker, S. M., Jr.
Gladding McBean & Co.
Roberts, John T.
Geo-Recon. Inc.
Schwarz, S. D.
Goodnews Bay Min. Co.
Vinnedge, R. W., Jr.
Great N. R'way Co.
Haley, Alva J.
Watson, Ralph A.
Haaland & Hoskins Assoc.
Hoskins, Charles B.
Hemphill Bros. Inc.
Hemphill, Wylie M.
C. Kirk Hillman Co., Inc.
Theis, Arthur J.
Ingersoll-Rand Co.
Humphrey, John R.
Tarrant, B. R.
Jenkins Engrg.
Jenkins, Albert C.
Kaiser Chem.
Olive, R. M.
J. M. Kniseley Engrg.
Kniseley, John M.
Kromona Cons. Mines Corp.
Marquette, Wm. H.

Virginia-Washington

Mineral Prod. Corp.
Waterman, Geo. H.
N.Y. Alaska Gold Dred. Corp.
Crowdy, James K.
No. Pacific Ry. Co.
Boyd, Glen A., Jr.
Hammond, Paul E.
McMillan, Earl R.
Pac. Car. & Fdy. Co.
Colman, John F.
Pyro-Mineral Engrg.
Bauer, Wolf G.
James S. Robbins & Assoc.
Robbins, James S.
Seattle Pub. Lab.
Richards, John S.
Univ. of Wash.
Anderson, Donald L.
Brien, Frederick B.
Daniels, Joseph
Goodspeed, G. E., Jr.
Pifer, Drury A.
Wadsworth, Dean K.
Wilcox, E. R.
Winter, Roger L.
U.S. Bur. of Mines
Geer, M. R.
Kelly, Hal J.
Magill, Elwin A.
McGuire, Louis H.
Sokaski, Michael
Yancy, H. F.
U.S. Dept. of Interior
Choi, Hyung Sup
Van Waters & Rogers
Burns, John S.
Victory Mines Corp.
Krom, Joe F.
Wheelabrator Corp.
Carrie, W. G.
No Data Supplied
Brennan, C. V.
Cole, Robt. J.
Dingle, Julius J.
Douglass, William L.
Goodwin, Robert C.
Griffith, William B.
Harlan, J. D.
Huber, Thomas N.
Hyatt, Milo J.
Irving, Irving G.
Jacobsen, Gordon L.
Johnson, George T.
Johnson, James L.
Johnson, L. G. E.
Kiger, J. Claude
Lewis, P. A.
Meals, John E.
Mercouriadis, A. N.
Moffitt, Robert C.
Naesens, Joseph E.
Nesdill, Edward T.
Nevin, N. M.
Ott, Willis H.
Richelsen, Walter A.
Roberts, Milnor
Runyon, John B.
St. John, Lee Harvey
Sands, Paul F.
Williams, Lewie
Wilson, Edmund G.
Wimmer, Norman L.

SPOKANE

Allis-Chalmers Mfg. Co.
Nesbitt, W. D.
Amer. Cyanamid Co.
Moyer, Samuel F.
Anaconda Co.
McNair, Wm. H.
Reed, William M.
Stephens, Edward C.
Atlas Coppo, Pac. Inc.
Milner, Carlos E., Jr.
Bear Creek Min. Co.
Holt, Robert E.
Lutz, Norman R.
Beth. Pac. Coast Steel
Schrager, M. F.
Burrows Geophys. Co.
Burrows, Lee J., Jr.
Diamond Drill Contr. Co.
Burrows, Lees J.
Empire Bearing Co.
Patterson, Lowell A.
Grandview Mine
Anderson, Ekil
Jasper, Karl W.
Hecla Mining Co.
Harper, Herbert E.
Quinlan, James J.
Joy Mfg. Co.
Swartz, Ralph R.
Kaiser Alum. & Chem. Corp.
Fetzer, Maurice C.
Masters Geophys.
Masters, Edwin S.
R. S. McClintock Diamond Drill Co.
Irwin, Philip H.
Weaver, Myron B.
Mines Management Inc.
Green, W. R.
Nat'l Equipment Co.
Walters, William M.

Washington-West Virginia

Pend. Oreille Mines & Met
Jensen, Jens
Zeigler, W. L.
Sidney Min. Co.
Barnes, E. K.
Sunshine Min. Co.

*Cole, John W.
Edgar, John
Garrett, S. K.
Hardy, Robert M. Jr.
King, Rowland
Osborne, Nathan J.
The Wash. Water Power Co.
Martin, Armor B.

U.S. Bureau of Mines
*Agnew, Wing G.
Howard, Thomas E.
*Hubbard, Charles R.
Popoff, Constanine C.
Romscher, William M.
Waddell, Glen G.
West, John M.

U.S. Air Force
Berthelote, T. F.
U.S. Bureau of Land
Management
Nelson, William
Smith, Joseph B.
U.S. Dept. of Int.
Jones, Paul L.
U.S. Geol. Surv.
Weissenborn, A. E.
Western Mach. Co.
Onaw, Edward G.

Witherspoon, Kelley, Davenport
& Toole
Neff, John Lewis
No Data Supplied
Birch, Frank E.
Burbridge, Frederick
Chadwick, Russ H. W.
Cloward, G. L.
Dolman, Phillips B.
Eichelberger, F. J.
Goddard, Charles C.

*Haffner, J. B.
Hundhausen, R. J.
Larson, Roy H.
*Leisk, Ross D.
Marsh, Jamie F.
McBroom, Horace R.
Moore, Bliss
Nichols, Walter J.
Nichols, John R.

*Oscarson, P. E.
Parsons, Edward W.
Rohy, Robert Neil
Sheeran, Harold Wm.
Sherman, Howard P.
Stowell, Wm. H.

TACOMA

Amer. Smelt. & Refin. Co.
Anderson, K. H.
Archibald, Frank W.
Bond, F. Arnold
*Bowman, Jan
Krisman, Emil M.
Leonard, W. C.
*Randt, Charles H.
Bennetts Chem. Lab. Inc.
*Maddess, Mathew S.
Hooker Chem. Co.
Judy, John W.
Kaiser Alum. & Chem. Corp.
*Rosene, Carl John
Robinson & Roberts
*Fryberger, John S.

Tacoma Test Lab.
*Jeklin, Lewis Edward
No Data Supplied
*Benson, Paul T.
Bowman, Robert A.
Gordon, Harold F.
Jackson, R. O.
Somerville, David A.
Thomsen, Denton

TRENTWOOD

Kaiser Alum. & Chem. Corp.
Eklund, Dalhart R.

VANCOUVER

Aluminum Co. of America
Beetem, David H.
Capps, Francis X.
No Data Supplied
Dilworth, J. B.
Houston, Harry L.

WALLA WALLA

U.S. Army Corps of Engineers
*Ames, Marshall B.
*Knox, James W.
No Data Supplied
Jansen, James O.

WELLPINIT

No Data Supplied
Wilson, James W.

WENATCHEE

Lovitt Min. Co., Inc.
Lovitt, E. H.
Thompson, Oscar D.
State of Wash. Dept. of H'ways
Lee, John P.
Stone & Webster Eng. Corp.
*Dahl, Doring C.
No Data Supplied
Welch, John R.

WINTHROP

No Data Supplied
Thomlinson, J. R.

YAKIMA

Sunshine Min. Co.
Hardy, Robert M.
No Data Supplied
*Oswin, Richard B.

WEST VIRGINIA

AFFINITY

Lillybrook Coal Co.
Crickmer, H. E.
Williamson, Robert B.

ALLOY

Union Carbide Metals Co.
Bloom, James A.

AMHERSTDALL

Guyan Eagle Coal Co.
Davis, John E.
No Data Supplied
Honaker, H. R.

ASHLAND

Ashland Min. Corp.
Oster, Howard S.

BARBOURSVILLE

No Data Supplied
Scott, Dennis K.

BARRACKVILLE

Bethlehem Mines Corp.
Gray, Latham B., Jr.
Kolwey, Herman G.
Lebo, Daniel E., Jr.

BARTLEY

Island Creek Coal Co.
Strunk, Thurston H.

BECKLEY

Ferguson-Gates Engrg. Co.
*Gates, Leslie C.
No Data Supplied
Caudill, L. V.
Hogue, Andrew O. B.
Putnam, L. T.
Shumate, J. L.

BERKELEY SPRINGS

Penna. Glass Sand Corp.
Murphy, Thos. D.
No Data Supplied
Dux, Herbert E.

BERWIND

New River & Poca. Cons. Coal
Co.
Gardner, Randall A.
Stemple, David T.

BLUEFIELD

Allied Chem. Corp.
Gillie, Percy
Ashland Coal & Coke Co.
Walker, Wm. W.
Daniels Co.
Richardson, J. B.
Leckie Mine Offices
Leckie, Fred D.
Melayne Pocahontas Coal Co.,
Inc.

*Workman, M. L.
Pocahontas Land Corp.
Graham, William R.
Lazer, Benjamin
No Data Supplied
Crickmer, D. F.
*Warden, Henry F.

BRIDGEPORT

No Data Supplied
Tudor, Benjamin A.

BUCKHANNON

Peck's Run Coal Co.
Williams, Frank E., Sr.
No Data Supplied
Tokarczyk, Stanley

BURNWELL

Imperial Collieries Co.
Stevens, David Woods, Jr.

CANNELTON

Cannelton Coal & Coke Co.
Morton, Paul

CARBON

Carbon Fuel Co.
Thomas, L. Newton, Jr.

CHARLESTON

Amherst Coal Co.
*Hopkins, A. S. J.
Jones, Herbert E., Jr.
Carbon Fuel Co.
Thomas, L. N.
Commercial Test. & Engrg. Co.
Lindsay, K. E.
Crab Orchard Coal & Land Co.
*Clark, James M., Jr.
Dickinson Fuel Co., Inc.
Dickinson, Charles C.
Kanawa Coal Oprs. Assn.
Flippen, C. J.
*Kennedy, Harry G.
Kanawha Mfg. Co.
Carver, Geo. E.
Kentland Coal & Coke Co.
Merrill, A. J.
McCoy Engrg.
*McCoy, J. Mayne
Robinson & Robinson
*Brownin, Guy
*Robinson, Carel
*Robinson, Neil
V. C. Smith Managt. Co.
*Smith, V. Courtland, II
United Carbon Co.
Stanton, E. C., Jr.
United Fuel Gas Co.
*Ferenz, Arthur M.
W. Va. Dept. of Mines
Lingo, Paul C.
W. Va. Eng. Co.
*Cree, J. O.
W. Va. State Road Com.
*Neely, Forest H.
No Data Supplied
Fitzgerald, P. H.
Gentry, William S.
Johnson, Todd T.
Lambie, Robert M.
Miller, James W.
Smith, Vealeir C.

CINDERELLA

Sycamore Coal Co.
Spotte, Irvin C.

CLARKSBURG

Hope Natural Gas Co.
Correll, Charles S.
Schradner, Bruce P.
The Texas Co.
Tetrick, Richard F.
No Data Supplied
Moore, T. D., Jr.

CLIFFTOP

Royalty Smokeless Coal Co.
*Allison, Blucher F.

COALBURG

C. E. Lawhead Trust. for Coal-
burg-Kanawha Min.
*Willis, John A., Jr.

COALWOOD

Olga Coal
Mauck, H. Eugene
Redfearn, Donald F.
*Ridenour, David C.
Waine, Charles R.

FAIRMONT

C. Ed. Berry Co.
*Berry, C. E.
Connell, Coal Co.
Williamson, Harry, Jr.
Fairmont Mach. Co.
Forman, James W.
Fairmont Supply Co.
Cavanagh, W. Curran, Jr.
Monongahela System
Potter, Don B.

FAIRMONT

C. E. Lawhead Trust. for Coal-
burg-Kanawha Min.
*Willis, John A., Jr.

COALWOOD

Olga Coal
Mauck, H. Eugene
Redfearn, Donald F.
*Ridenour, David C.
Waine, Charles R.

FAIRMONT

C. Ed. Berry Co.
*Berry, C. E.
Connell, Coal Co.
Williamson, Harry, Jr.
Fairmont Mach. Co.
Forman, James W.
Fairmont Supply Co.
Cavanagh, W. Curran, Jr.
Monongahela System
Potter, Don B.

Mountaineer Coal Co.
Higinbotham, George R.
Hylton, William T.
Judy, Geo. L.
*Washburn, Harry L.
No Data Supplied
Bowling, Arthur, Jr.
Conrad, Chester S.
Monell, Louis F.
Poole, Arthur S., Jr.
Prunty, M. E., Jr.
Williamson, Norman L.
Zona, Anthony

FOLLANSBEE

No Data Supplied
Jordan, Preston E.

FORT SPRING

Acme Limestone Co.
McThenia, A. W.
Rigg, J. A.
*Ruby, William H.

GARY

U.S. Steel Corp.
Anderson, John C.
Anderson, Robert B.
Bloomberg, James M.
Caffrey, John E.
Connor, C. W., Jr.
Gillison, Geo. T.
Hayduk, Martin
King, Donald T.
Walrod, Gordon H.
Watson, Paul E.

GORMANIA

No Data Supplied
Renn, William F.

GRANT TOWN

Eastern Gas & Fuel Asso.
Bastie, Joseph C.
No Data Supplied
Laird, William

HOLDEN

Island Creek Coal Co.
Burch, Elza Fain
Camiciis, N. T.
Hodder, Edwin J., Jr.
*Menk, Ferdinand C.

HUGHESTON

Crucible Steel Co.
Min, Zin

HUNTINGTON

Assoc. Engrs. Inc.
*Chedsey, George L.
Bituminous Coal Res. Inc.
Von Stroh, G. F. H. II
Chesapeake & Ohio Rwy. Co.
Herrington, J. Byron
*Hoover, Guy E.
McDaniel, W. Darrell
Toothman, Fred R.

COAL LAND SERVICES INC.

*Stark, William D.
Dingess-Rum Coal Co.
Stark, Tom
Ingersoll-Rand Co.
Haase, Conrad C.

ISLAND CREEK COAL SALES CO.

Doherty, Joseph D.
Hamilton, J. L.
Lazzell, J. Glenn
*Moore, Walter S.
Salvati, Raymond E.
Link-Belt Co.
Lammers, Kenneth M.
Stevens, David W.

B. H. MOTT & SONS INC.

Mott, Burton H., Jr.
Mott Core Drill Co., Inc.
Mott, B. H.
Princess Coals Inc.
Francis, David L.
Roberts & Schaeffer Co.
Blood, William W.
No Data Supplied
Howard, Charles N.
*Lawall, Charles E.
Sefton, E. Floyd

KAYFORD

Trux-Traer Coal Co.
*Cuthbert, W. R.
Luxner, James V.
Shumate, Mack H.
No Data Supplied
Tibbs, Harry M.

KENOVA

No Data Supplied
Bishop, Jack M.

KIMBALL

No Data Supplied
Smith, Herman C., Jr.

KIMBERLY

No Data Supplied
*Reece, F. P.

KOPPERSTON

East. Gas & Fuel Assoc.
Reedy, Donald M.

LOGAN

U.S. Bureau of Mines
Whalen, James C.

LORADO

The Lorado Coal & Min. Co.
Milan, Marcus L.
No Data Supplied
Bobella, John C.

MADISON

Westmoreland Coal Co.
*Muron, Phillip K., Jr.

MALLORY

Princess Coals Inc.
Crawford, William
Spotte, A. E.

MAN

No Data Supplied
Stanley, Charles E.

MARMET

Eastern Gas & Fuel Asso.
Nash, Edgar

MARTINSBURG

Jones & Laughlin Steel Corp.
Alter, George E., Jr.
Van Evera, James W., Jr.
Stand. Lime & Cem. Co.
Craig, Irving M., Jr.
Mueller, Louis J.
No Data Supplied
Gillenwater, J. B.

MONONGAH

Mountaineer Coal Co.
Giley, James E.

MONTGOMERY

Armco Steel Corp.
Kane, C. O.

MONTGOMERY

Allied Chem.
Noone, William Hackett

MORGANTOWN

Christopher Coal Co.
*Barnard, William O.
W. Va. Geol. Survey
*Price, Paul H.
West Virginia Univ.
*Ludlum, John C.
*McClung, Joseph D.
Murphy, Elmer Louis, Jr.
Sandy, E. J.
*Spindler, G. R.
No Data Supplied
Miller, Fred H.
Mitchell, Francis J.
Sharpenberg, W. O.

MOUNDVILLE

Hanna Coal Co.
Goddard, William Paul
McCaig, George W.
*Sarf, C. L.

MOUNT HOPE

Gulf Mining Co.
Graney, Patrick C.
The New River Co.
Bourland, Charles R.
Howard, Thomas William
U.S. Bureau of Mines
*Fitzgerald, Lloyd G.
No Data Supplied
Bourland, White
Stortz, Frank J.

NEWELL

Globe Brick Co.
*Lee, Richard W.

OAK HILL

No Data Supplied
Long, John B.

OSAGE

Christopher Coal Co.
Fowler, Cleon R.
Nailier, C. R.

PINEVILLE

Redyard Coal Co.
Redyard, Jesse

PURSGLOVE

Christopher Coal Co.
Zachar, F. R.

RALEIGH

Raleigh Coal & Coke Co.
Burmeister, R. J.

RAWL

No Data Supplied
Stewart, Fred F.

ST. ALBANS

J. M. Huber Corp.
Griffith, Robert F.

SHARPLES

Boone City Coal Corp.
Jack, J. L.
Wesner, Richard F.

SHINNSTON

J. C. Hydraulics Inc.
Byers, William E.

SLAB FORK

Slab Fork Coal Co.
Caperton, S. Austin
No Data Supplied
Bays, Neil Elwyn

SO. CHARLESTON

No Data Supplied
Stasch, Franklin E.
Rees, T. R.

SUMMERSVILLE

S. D. Brady, Jr.
Brady, S. Dunlap, Jr.
Brady, S. D., III

TAMS

Winding Gulf Coal Inc.
Bowman, E. V.

THOMAS

Western MD. R'way Co.
Wooters, Robert B.

TRALEE

Allied Chem. Corp.
Dado, Ralph Joseph

TRIADLEPHIA

Valley Camp Coal Co.
Haake, Donald R.

WAI

No Data Supplied
Pudlo, George H.

WEIRTON

Weirton Steel Co.
Dougherty, Sylvester J.

WHARTON

East Gas & Fuel Assoc.
Patzig, Peter R.

WHEELING

Greenland Coal Sales Inc.
Burt, William L.

The Valley Camp Coal Co.
Cunningham, David S.
Wheeling Steel Corp.
Davis, E. Tyler
Whitaker, Albert C., Jr.

WIDEN

Elk River Coal & Lumber Co.
Beattie, Harold L.
Ketchka, Edward R.

WILLIAMSON

Osborne Min. Corp.
Carter, James D.
No Data Supplied
Good, W. E.

WYOMING

W. M. Ritter Lumber Co.
Cooke, Harry, G., Jr.
Glover, Charles L.

WISCONSIN**APPLETON**

No Data Supplied
Bruce, William Earl

ASHLAND

No Data Supplied
Goldsmith, M. C.

BENTON

No Data Supplied
Farrey, Henry B.

CECIL

No Data Supplied
Bocher, Robert J.

CEDARBURG

No Data Supplied
Moldenhauer, M. I.

DARLINGTON

No Data Supplied
Wisco, Harold A.

EAU CLAIRE

No Data Supplied
McLaughlin, Wm. R.

GREEN BAY

No Data Supplied
Sweetman, Edwin

HALES CORNERS

No Data Supplied
Bond, Jack B.
Buus, Harold W.

HUDSON

No Data Supplied
Slaughter, Wm. F.

HURLEY

Pickands Mather & Co.
Swanson, Arden W.

MADISON

Univ. of Wisconsin
Cameron, Eugene W.
Clark, Lewis Donovan
Kowalke, O. L.
Lowe, Donald F.
Matech, Gerald J.
Nelson, Roger R.
Scott, James J.
No Data Supplied
Anderson, R. D.
Christmann, C. W.
Smith, David Post

MAUSTON

No Data Supplied
Dusell, Harry N.

MELLEN

Bear Creek Min. Co.
Moerlein, George A.

MENASHA

City of Menasha
Haas, Bruno Joseph

MILWAUKEE

Allis Chalmers Mfg. Co.
Agthe, Fred Thomas
Bergstrom, B. H.
Bond, Fred C.
Briber, Frank E., Jr.
Gibson, John K.
Halstead, Robert L.
Kobanowski, Frank Igor
Krouse, George F.
Mitchell, Will, Jr.
Nice, John A.
Puermer, Bertram H.
Rousseau, Edwin S.
Rowland, Chester A., Jr.
Singleton, Joseph L.
Sollenberger, C. L.
Stahl, Harvey L.
Bucyrus-Erie Co.
Black, Lewis C.
Freyensee, Howard
Nice, Milo A., Jr.
Chain Belt Co.
Snaveley, J. Walter
Dings Magnetic Separator Co.
Bass, Charles G.
Gille, Kenneth L.
Manegold, Robt. L.
Falk Corp.
Hood, Kenneth
Toepfer, Peter H.
Harnischfeger Corp.
Raubach, Gerald T.
The Jeffrey Mfg. Co.
Bradshaw, Wilbur L.
Milwaukee Solvay Coke Co.
Mueller, Albert P.
Mineral Min. Co.
Van Dyke, William A., Jr.
Nordberg Mfg. Co.
Meaders, R. C.
Reckin, George M.
Schaal, Richard G.
Zorber, Howard M.
Stearns Magnetic Products
Bronkala, William J.
Westinghouse Air Brake Corp.
McChain, R. L.
No Data Supplied
Boerner, Alfred E.
Burnett, C. E.
Chermes, W. J.
Haskins, Robert J.
Rodgers, Ray W.
Shockley, Wray A.
Woody, Guy V.

MINERAL POINT

No Data Supplied
Ivey, Charles R.

MONTREAL

Ogle Bay Norton Co.
Holgers, R. H.
Soine, Gordon S.
Young, Dan S.
No Data Supplied
Baxter, William S.
Fritz, Donald E.
Magnuson, George B.

NEENAH

Kimberly-Clark Corp.
Hall, Roger Rowen

OCONOMOWOC

No Data Supplied
Buchner, Carl F.

PLATTEVILLE

The N. J. Zinc Co.
Hague, John M.
Zwickey, Wayne R.
Piquette Min. & Milling Co.
Piquette, F. B.
Wis. Inst. of Tech.
Broughton, W. A.
Palmer, Harris A.
No Data Supplied
Byrne, Richard J.
Gronbeck, Marius P.
Mullens, Thos. E.

PRAIRIE DU CHIEN

Wis. Farmco Service Corp.
Sherman, David M.

SHULLSBURG

Amer. Zinc, Lead & Smelt. Co.
Kettler, George H.
The Eagle-Fischer Co.
Stock, Charles M.
J. D. Judd Drilling
Judd, J. D.
Moore & Siegal
Siegal, Eddie

SOUTH MILWAUKEE

Bucyrus-Erie Co.
Calland, W. D.
Coleman, William W.
MacDonald, L. E.
Rumfelt, Henry F. C.
Thornton, Harry

WAUKESHA

No Data Supplied
Eaton, Lucien, Jr.
WAUWATOSA

No Data Supplied
Hackett, Wm. F.

WEST ALLIS

Allis Chalmers Mfg. Co.
Baza, Edward H.
No Data Supplied
Aguirre, Luis E.

WYOMING**CASPER**

U.S. Atomic Energy Comm.
Haines, G. Irving
Norton, David L.
Smith, M. Clifford, Jr.
No Data Supplied
Beasley, H. F.
Butler, Miff M.
Elliott, D. H.
Ellis, John R.
Hadfield, J. P., Jr.
Krahi, Duon
Krummell, William J., Jr.
Nielsen, Merrill L.
Wallway, Marvin J.

CHEYENNE

Wyo. Natl. Res. Bd.
Buchanan, J. A.
No Data Supplied
Johnson, V. Z.

CODY

Gibbons & Reed
McGlothlin, Wm. K.

DOUGLAS

No Data Supplied
Ludden, R. W., Jr.

EVANSTON

No Data Supplied
Young, Neil B.

FRONTIER

The Kemmerer Coal Co.
Sorenson, G. E.
Townsend, Donald Hunt

GREEN RIVER

Intermountain Chem. Co.
Bernatis, Thomas S.
Fischer, William G.
Hash, Bender
Van Denburg, James F.

GUERNSEY

No Data Supplied
Erickson, Neil E.

HOME ON THE RANGE

Western Nuclear Corp.
Fuller, B. J.

West Virginia-Wyoming

No Data Supplied
Knocke, Louis C.

JACKSON

So. Calif. Mineral
Joy, Charles F.

LAMONT

Bellamy & Sons
Bellamy, Ben C.

LANDER

Western Nuclear Corp.
Fulmer, J. W.
No Data Supplied
Clark, Elton
Lund, F. Rupert

LARAMIE

Union Pac. Min. Dev.
Simons, John P.
Univ. of Wyo.
Duncan, Walter E.
Fisk, Henry G.
Frostel, Edward
Wilson, William H.

LOVELL

Lisbon Uran. Corp.
Christie, R. L.
National Lead Co.-Bar. Div.
Castelli, August V.

MORAN

No Data Supplied
Burt, Maxwell S.

RAWLINS

Western Nuclear Corp.
Cenis, Don L.
Falmerserv, Richard J.
Joyce, Joseph W.
Kehrwald, Richard J.
Newman, Eric
Thomas, Peter N.
U.S. Atomic Energy Comm.
King, David P.
Meschter, Daniel Y.

RIVERTON

Fed. Radorock-Gas Hills & Partners
Lindlof, Raymond G.
Fed. Uran. Corp.
Condie, Bruce
Freemont Min. Inc.
Bryant, Gerrett H.
Bullock, G. Eugene
Globe Min. Co.
Bagan, Richard J.
Taylor, I. Robert
Lucky Mc Uranium Corp.
Anderson, Don C.
Chapin, Charles E.
Price, Ted O.
Quine, A. V.
Shoshone Ore Co.
Moore, Irving F.
Utah Mining Corp & Utah Dev. Co.
Anderson, John S.
Atkins, John T.
Clark, Leonard C.
Kearly, Earl Edgar William
Palmer, Robert A.
Pimentel, J. E.
Pratt, Morton E., Jr.
No Data Supplied
Adamson, Robert D.
Ford, Robert B.
Korber, Robert F.
Ternahan, J. C., Jr.

ROCK SPRINGS

Union Pacific Coal Co.
Charles, I. M.
Murray, V. O.
No Data Supplied
Hughes, John B.

SUNRISE

Colo. Fuel & Iron Corp.
Lynch, Hugh B.
MacCannon, Robert W.
Sisson, Myron L.
Wahl, Roy L., Jr.

FOREIGN

NORTH AMERICA

CANADA

ALBERTA

CALGARY

Alberta Coal Ltd.
Doerr, C. F.
Shell Oil Co. of Canada
Nicolaou, Anthony D.
No Data Supplied
*Corey, B. H.
Diamond, R. W.
Munn, Thomas H.
*Rawles, William P.

EDMONTON

Cal. Standard Co.
Allan, J. Donald
Eldorado Mining & Ref.
Cowdery, P. H.

FORT SASKATCHEWAN

Sherritt Gordon Mines Ltd.
Evans, David J. I.

LETHBRIDGE

Lethbridge Collieries Ltd.
Livingstone, R. Donald

OKOTOKS

Texas Gulf Sulphur Co.
Ronicker, Fred J.
Univ. of Alberta
*Leja, Jan
*Lilje, E. O.

BRITISH COLUMBIA

ALICE ARM

Torbritt Silver Mines Ltd.
Bapty, Harry

ALLENBY

Granby Cons. M.S. & P. Co. Ltd.
Laird, A. M.

ASHCROFT

Bethlehem Copper Corp.
*Hamilton, Robert E.

BRITANNIA BEACH

Howe Sound Co.
Smith, Archibald T.

CASSEAR

Cassear Asbestos Corp.
Bronson, C. E.

CHAPMAN CAMP

No Data Supplied
Ruffie, James A.

COPPER MOUNTAIN

No Data Supplied
Ross, J. A. C.

COQUITLAM

Kennametal Inc.
*Stoll, W. M.

KELOWNA

Wormec Helicopter Exp.
*MacKenzie, W. J.

KIMBERLEY

Consol. Ming. & Smelt. Co.
Gibney, William H. R.
Giegerich, Joseph R.
Robertson, A. G.
Trenaman, R. T.
No Data Supplied
Hammond, H. R.
Hodgson, Stanley
Sevensma, P. H.

NELSON

Sheep Creek Mines Ltd.
Doelle, H. E.
McIntosh, J. S.

No Data Supplied
*Mahan, Robert B.

NORTH BURNABY

Atlas Copco Canada Ltd.
Lambert, Donald P.

PRINCETON

No Data Supplied
Sadar, Edward

REMAC

Reeves MacDonald Mines
*Thompson, F. R.

SALMO

Canadian Explor. Ltd.
Stearns, H. A.
*Weber, Robt. G.

SALT SPRING ISLAND

No Data Supplied
*Bates, Bennett R.

TRAIL

Cominco
Armstrong, Robt. J.
Campbell, D. S.
Clayton, George E.
Shelley, Rowland B.
Telfer, Leonard
Walton, T. F.
No Data Supplied
Bloomer, P. T.

VANCOUVER

Amer. Smelt. & Ref. Co.
Stevenson, Wm. G.
Beaver Lodge Uranium Mines Ltd.
Sirola, William M.
Bralorne Pioneer Mns. Ltd.
Dobson, Percy G.
B.C. Engrg. Co. Ltd.
*Weymark, W. J.
Canadian Explor. Ltd.
Gordon, Gerald A.
McFarland, Cole E.
R. C. Clough Eng. Ltd.
*Cohen, Harvey H.
Conwest Explor. Ltd.
Rotherham, Donald C.
Granby Mining Co. Ltd.
Postle, L. T.
Hill Starck & Assoc.
*Starck, L. F.
Makoo Dev. Co. Ltd.
*Neilson, W. I.
Newmont Min. Corp. of Can.
Norman, G. W. H.
Pike, James A.
Nimkish Iron Works Camp
Burns, David W.
Noranda Explor. Co. Ltd.
Brynnelsen, B.
Placer Dev. Ltd.
McClelland, Thomas H.
Simpson, John D.
Southwest Potash Corp.
De Leen, John L.
Univ. of B. C.
*Forward, F. A.
Gillett, F. G. M.
Howard, Henry M.
Sargent, T. E. H.
*Warren, Harry V.
Ventures Ltd.
Smith, Alexander
Wright Engineers Ltd.
*Wright, Leonard F.
Yukon Cons. Gold Corp. Ltd.
McFarland, W. H. S.
No Data Supplied
Burton, Alexander D.
Cannon, Donald W.
Coveney, C. J.
*Hall, Arthur O.
*James, H. T.
Kent, A. D.
Kidd, Desmond F.
Lipsey, G. C.
*McDougall, B. W. W.
O'Brien, M. M.
*Papenfus, Edward B.
Roper, E. C.
Spry, Russell J.
Steiner, Robert R.
Taylor, Austin C.

MANITOBA

BISSETT

No Data Supplied
Reynolds, G. F.

FLIN FLON

Hudson Bay Min. & Smelt. Co. Ltd.
Carr, J. D.
Fairbairn, John Barton
*Kerns, Brian
Mussio, Sergio Gino
Robertson, D. J.

LYNN LAKE

Sherritt Gordon Mines Ltd.
Cain, Peter A.
Folinsbee, John C.
George, L. Max
Hales, F. William
*Hales, Heath H.
No Data Supplied
MacLellan, J. A.

THOMPSON

Intl. Nickel Co.
Dante, Richard E.
Power, John T.

WINNIPEG

Forsberg Mining Ltd.
Rankin, John D.
Gardner Denver Co. (Canada) Ltd.
Caverly, Jefferson A.
International Nickel Co. of Canada Ltd.
Parlee, James C.
Newmont Mining Corp. of Canada Ltd.
Drybrough, John
No Data Supplied
Brehaut, Roy C.
McCue, J., Jr.
*Smerchanski, Mark G.

NEW BRUNSWICK

BATHURST

Anacoda Co. (Canada) Ltd.
Kierans, Martin D.

FREDERICTON

No Data Supplied
Clements, C. S.
Wright, William J.

NEWCASTLE

McIntyre Porcupine Mines Ltd.
Moore, John C. G.

NEW CASTEL

Heath Steel Mines Ltd.
Reidings, A.

ZEALAND

No Data Supplied
Estey, Arol W.

NEWFOUNDLAND

BUCHAN

AIRBORO

Brown, Richard L., Jr.
Miller, Robert L.
Pilz, Conrad W.
Swanson, Eric A.

TILT COVE

Maritimes Mng. Corp. Ltd.
Adams, William S.
Busse, Egon
Perry, Edward J.

WABANA

Dominion Wabana Ore Ltd.
Paddon, Roy H.
Southey, V. J.
No Data Supplied
Waterland, T. M.

NORTHWEST TERRITORY

YELLOWKNIFE

Giant Yellowknife Gold Mines Ltd.
Irvine, Donald J.
Tait, Robt. J. C.
Indian Mt. Met. Mines Ltd.
*Moffat, William Windeler
Rayrock Mines Ltd.
Lowe, Evan A.

NOVA SCOTIA

HALIFAX

Cameron & Cameron
*Cameron, Alan E.
Nova Scotia Tech.
*Cameron, E. Lee
No Data Supplied
Mackenzie, Thomas G.

SYDNEY

Dominion Steel & Coal Corp.
Frost, Louis
No Data Supplied
Sigut, George

ONTARIO

AGINCOURT

J. C. Honsberger Ltd.
*Honsberger, J. C.

ALGOMA MILLS

Pronto Uranium Mines, Ltd.
Karim, Inayat

ATIKOKAN

Caland Ore Co. Ltd.
Bishop, M. R. L.
Ribotto, Peter P.
Peterson, E. Warren
Canadian Charleson Ltd.
Maki, John O.
No Data Supplied
Magee, J.
Proehl, Norman P.

BALMERTON

New Dickenson Mines Ltd.
Buchholz, Donald H.
No Data Supplied
Fell, F. A.

BANCROFT

Bicroft Uranium Mines Ltd.
Lillie, Douglas F.
Thompson, John M.
Thomson, Barton A.
Faraday Uranium Mines
Roach, R. J.

BEACHVILLE

No Data Supplied
Dies, George D.

BEARDMORE

Leitch Gold Mines Ltd.
McKay, G. A.

BRIGHTON

No Data Supplied
*Fox, Campbell

COCHENOUR

Cochenour Willans, Gold Mines Ltd.
Huckins, Daniel L. E.

COPPER CLIFF

Intl. Nickel Co. of Canada
Benard, Frederic
De Vletter, D. R.
Dunham, C. R.
Holt, Michael G.
Lee, James Edwin
Mutz, Herman J.
Poll, Jay A.
Taylor, R. R.
Thorpe, George M.
Todd, F. Foster
Wager, R. E.
Zurbrigg, H. F.

No Data Supplied
Frame, G. A.
Gaetz, T. M.
Pigott, John A.

CUTLER

Noranda Mines, Ltd.
Morrison, Bernard H.

DOBIE

Upper Canada Mines
*Waterland, T. M.

DON MILLS

McPhar Geophysics, Ltd.
*Sutherland, Donald B.
*Hollof, Philip G.
No Data Supplied
Evans, Howell T.
Giedhill, T. R.

ELLIOT LAKE

Algom Quirke
Bayko, John H.
Dresner, N.
Northspan Uranium Mines, Ltd.
Fitzpatrick, J. J.
McNeil, S. W.
Panel Uranium Mine
MacLeod, John
Spanish American Buckles Mine
Warren, Clayton E.
Stanleigh Uranium Mines
Burns, Robert D.
Stanrock Uranium Mines
Jones, F. R.
Kettleison, Harold
*Walkey, Graham W.

FALCONBRIDGE

Falconbridge Nickel Mines
Berry, H. T.
Finlay, J. E.
Fraser, J. H.
Healy, Ed. L.
Mutch, A. D.
O'Brien, James M.
Rivett, Louis S.

FONTHILL

No Data Supplied
McDonald, J. Craig

GALT

Joy Mfg. Co. (Canada) Ltd.
Ross, D. W. M.

GUELPH

No Data Supplied
Cox, Bart

HAGERSVILLE

Canadian Gypsum Co.
McGrath, Clifford F.

HAILEYBURY

Pioneer Consultants Ltd.
Lavigne, M.
Provincial Institute of Mining
Atchison, Daniel W.
No Data Supplied
Angus, O. H.
*Thoday, Gerald P.

HAMILTON

Dom. Foundries & Steel Co.
Loosley, F. A.
Steel Co. of Canada Ltd.
Chisholm, J. T.

HOLTYRE

Ross Mine
Caylor R. D.

JAMESTOWN

Algoma Ore Prop., Ltd.
James, C. Roy
Palmer, R. F.

KINGSTON

Aluminum Laboratories Ltd.
Hay, Robert H.
Queens Univ.
*Corlett, A. V.
Lord, T. V.

North America-North America

KIRKLAND LAKE

Wright Hargreaves Mines
Hotchkin, M. W.
Hotchkin, Merritt W.

LAKEFIELD

Lakefield Res. Canada, Ltd.
Allen, Jules P.
Hubler, W. G.
No Data Supplied
Douglas, George M.

LIVELY

Int'l. Nickel Co.
Write, Sherman A.

LONDON

Univ. of West Ontario
*Uffen, Robert J.

MADSEN

Madsen Red Lake Gold Mines
*Crayston, Edmund G.
Van Loon, L. H.

MANITOUWADGE

Geco Mines, Ltd.
Jokisch, C. R.
Lanchester, Frank
Marshall, G. Merle T.
No Data Supplied
Doyle, Donald M.

MARMORA

Marmoraton Mining Co., Ltd.
Lorenson, C. Alvin
Olsen, Harold O.
No Data Supplied
McChesney, J. S. K.

MATHESON

Canadian Johns-Manville Co.,
Ltd.
Baker, Robert D.

MACKENZIE ISLAND

Mackenzie Red Lake Gold
Mines
Young, Horace G.

NEW LISKEARD

Langie Silver & Cobalt
Mining Co.
*Jerome, J. E.

NIAGARA FALLS

H. C. Acres & Co. Ltd.
Cook, R. H.
Carborundum Co.
Anthes, Lester B.
Cyanamid of Canada Ltd.
McDonald, F. L.
No Data Supplied
Magyar, William B.

NORTH BAY

Canadian Longyear Ltd.
*Mason, Cecil A.
*Stevenson, J. G. A.
No Data Supplied
Warren, R. A.

ANAPING

Falconbridge Nickel Mines Ltd.
Makarinsky, Frank M.
Weglo, John Karl

OAKVILLE

No Data Supplied
*Jenney, C. Philip

OTTAWA

Canadian Gov. Dept. of Mines
& Tech. Survey
Buck, W. Keith
Chwastiak, Stephen
Elver, Robert B.
Haw, Victor A.
Haylip, G. O.
Ignatieff, Alexis
McCreedy, H. H.
Pickett, Daniel E.
Reeves, John E.
Smith, Harold Wm.
Woodroffe, H. M.
Wyman, R. A.
Carleton Univ.
Riddell, John E.
Eldorado Mining & Ref. Ltd.
Barrett, Richard E.
Bennett, W. J.
*Thunauer, Arvid
Wright, Anthony J.

Int. Min. & Chem. Corp.

(Can.) Ltd.
Hood, Walter H.
Nat'l. Res. Council
Lathé, Frank E.
N. J. Zinc Expl. Co. (Canada)
Ltd.
Goranson, E. A.
M. J. O'Brien, Ltd.
Scott, Alan
Quebec Metallurgical Ind. Ltd.
*Davis, Norman B.
Stratmat Ltd.
Monture, Gilbert C.
No Data Supplied
Banks, H. R.
Finlayson, Donald G.
Frechette, Howells
*Goudge, M. F.
*King, A. Charles
*Spence, Hugh S.
Wieduwilt, Wm. G.

PAMOUR

No Data Supplied
Honsberger, J. A.

PORT ARTHUR

Anaconda Co. (Canada) Ltd.
Brinley, Edward H.
Anacoda Iron Ore (Ontario)
Ltd.
Coile, James J.
Knaebel, John B.
Bartley, Green & Assoc.
*Bartley, M. W.
Cliffs of Canada, Ltd.
*Riedel, Robert W.
No Data Supplied
Emmerson, E. Roy

PORT COLBORNE

Int'l. Nickel of Canada, Ltd.
Head, M. D.

PORT CREDIT

No Data Supplied
Knight, Cyril W.

ROSEBANK STATION

No Data Supplied
Mackerscher, D. M.

ST. CATHERINES

Thompson Prod. Ltd.
Simpson, Peter S.
Stauffer, George A.
*White, George A.
W. S. Tyler Co. of Can. Ltd.
Aaroe, S. L.

ST. FELECEN

Campbell Chibougamau Mine
Walker, Arnold M.

SARNIA

Dow Chem. of Canada, Ltd.
Rowe, Robert B.
No Data Supplied
Craven, W. C.

SCARBOROUGH

No Data Supplied
Boyko, W. P.
Shaw, William W.

SCHUMACHER

McIntyre Porcupine Mines, Ltd.
Carter, John Manning
Griffis, A. Thomas
Jackson, M. E.
Johnson, Eric W.

SOUTH PORCUPINE

Dome Mines, Ltd.
*Girdwood, Charles P.
Preston East Dome Mines, Ltd.
*Lane, H. C.
No Data Supplied
Perry, Robert J.

SPRAGGE

Can-Met Explor., Ltd.
*Fowler, Howard M.
Cons. Denison Mines, Ltd.
Bracken, J. M.
Futterer, Edward, Jr.
Kostuk, John
Smith, D. B.

STEEP ROCK LAKE

Steep Rock Iron Mines, Ltd.
Fotheringham, M. S.
Hancock, Sydney G.
Zahary, George

SUDBURY

Falconbridge Nickel Mines, Ltd.
Mott, R. Clare
Rockiron Co., Ltd.
Chlumecky, Nicholas
No Data Supplied
Austin, E. T.
*McKechnie, D. C.

SWASTIKA

Swastika Lab. Ltd.
Kerr-Lawson, D. E.
No Data Supplied
McBean, John W.

SYDENHAM

No Data Supplied
*Dickey, Herbert P.

TIMMINS

Aunor Gold Mines, Ltd.
Morgan, D. M.

TORONTO

Am. Metal Climax, Inc.
*Robinson, Wm. A.
Am. Nepheline, Ltd.
Deeth, Harold
ASARCO Explor. Co. Canada
Ltd.
Sprague, Rodney B.
Whiting, Keith
Anacoda Co. (Canada) Ltd.
Brown, P. K.
Corbett, John D.
Swensen, William T.
Anacoda Iron Ore (Ontario)
Ltd.
Gourd, Jean J.
Anderson, Finney & Paterson
Anderson, J. Murray
Assoc. of Prof. Engrs. of
Ontario
Keefer, Thomas C.
Barymin Explorations
*Wigle, G. P.
M. J. Boylen Engrg.
*Almstrom, Adne A.
Campbell Chibougamau Mines
*Malouf, Stanley E.
Canadian Aero Service
*Pemberton, Roger H.
Canadian Business Service, Ltd.
Hudson, Adrian S.
Canadian Gov't., Dept. of
Mines
Rickaby, H. C.
Canadian Nickel Co., Ltd.
Michener, Charles E.
Canadian NW Mines & Oils,
Ltd.
*Jeckell, Allen W.
Can-Fer Mines
*McChesney, Robt. D. R.
Carbide Chemicals Co.
Brown, R. A.
Chesbar Chib. Mines, Ltd.
*Dumont, Georges H.
I. C. Christopher, Ltd.
*Christopher, I. C.
Cyanamid of Canada, Ltd.
Almone, Frank M.
Denver Equip. (Canada) Ltd.
*Stain, W. J.
Dome Mines, Ltd.
Redpath, James B.
Du Pont of Canada, Ltd.
Humbley, C. T.
Surrett, Edward J.
Electro-Metallurgical Co.
Gamble, Terry S.
Ensis, Whitton & Assoc., Ltd.
*Elliott, Robert A.
Falconbridge Nickel Mines Ltd.
Archibald, F. R.
McGrodan, Peter B.
Mitchell, Geoffrey P.
Frobisher, Ltd.
Edward, Bruce G.
Walker, W. R. G.
Gardner Denver Co. (Canada)
Ltd.
Henderson, J. R.
Gen. Engrg. Co. Ltd.
*Bourke, D. E.
*Hamilton, P. D. P.
*Hamilton, R. M. F.
S. L. Good & Co.
Clifton, Frank
Halet, Broadhurst & Ogden
*Broadhurst, P. S.
*Ogden, Michael
Hardinge Co., Inc.
*Robinson, Bertrand G. W.
Hopkins Exploration Consol.
Hopkins, Albert
Hunting Assoc., Ltd.
*Willson, Gray S.
Hunting Tech. & Expl. Services
*Hogg, Nelson
*Paterson, Norman R.
C. C. Huston & Assoc.
*Huston, Chas. C.

Imperial Bank of Canada
Redrupp, R. J.
Int'l. Nickel Co. of Canada
Ltd.
Parker, Ralph D.
Int'l. Mine Services
*Newman, W. R.
Inver Corp., Ltd.
*Archibald, C. W.
W. F. James & B. S. W. Buffam
*Buffam, B. S. W.
*Cooper, Marsh, A.
Keneco Explorations, (Canada)
Ltd.
Brooks, Robert R.
Sullivan, C. J.
Kerr-Addison Gold Mines, Ltd.
Row, William S.
Kilborn Engrg. Ltd.
*Crocker, Bunting S.
*Dewar, K. M.
Lundberg Explorations, Ltd.
*Lundberg, Hans T. F.
*Sikka, D. B.
Wilson, Basil T.
McIntyre-Porcupine Mines
Keefer, John A. C.
Urguhart, M. L.
Mine Equipment Co. Ltd.
Childerhose, T. M.
Edgerley, J. D.
Gunn, J. E.
Modern Geophysical, Ltd.
*Evans, J. Helier
Moneta Porcupine Mines, Ltd.
Burton, Fred R.
Newcomex
Bowker, C. E.
Newmont Min. Corp. of Canada
Murphy, Richard F.
New Cons. Canadian Expl. Ltd.
Brashear, B. J. F.
New Mylomaque Explor., Ltd.
*Booth, John R.
*Weaver, B. Douglas
Noranda Mines, Ltd.
McLachlan, C. G.
Murdoch, James Y.
Porritt, Richard V.
Northern Miner
Carrington, J. W.
Pearce, Norman C.
Ontario Dept. of Mines
Hurst, Macleod E.
Ontario Res. Foundation
*Cavanagh, Raymond L.
Ontario Securities Comm.
Whatnough, J. K.
Osisko Lake Mines, Ltd.
Maxwell, W. B.
Phipps Dodge Corp. of Canada,
Ltd.
Hutchison, W. A.
Rio Tinto Min. Co. of Canada
Ehrlich, R. P.
*Joubin, Francis R.
Roach, A. G.
Roraima Mining, Ltd.
*Jungersen, Thøger G.
A. H. Ross & Assoc.
*Ross, Alvin H.
*Ward, Ernest W. S.
Selco Exp. Co., Ltd.
Parks, T.
Sheritt Gordon Mines, Ltd.
Gallie, Alan E.
Simard & Knight & Assoc.
*Simard, Lionel R.
*Smith, Van H.
Southwest Potash Corp.
Barker, R. A.
Steep Rock Iron Mines
*Samuel, W.
Sulmac Expl. Service
*Fredergast, J. B.
Femagami Mining Co.
*Keevil, Norman B.
Terratest Co. Ltd.
*Powelson, J. M.
Univ. of Toronto
*Cox, Geoffrey A.
Haultain, H. E. T.
*Manacelli, R. W.
*Rice, H. Ralph
Ross, H. U.
Ventures, Ltd.
*Dunn, William
Fraser, Horace J.
McGowan, H. S.
Salt, D. J.
Viola Mac Mines, Ltd.
MacMillan, Mrs. Viola R.
No Data Supplied
*Bateman, J. D.
*Beaton, Neil S.
Bonniwell, J. B.
Buckles, H. R.
*Chamberlin, L.
Dean, A. W.
*Ditchburn, H. F.
*Dumbrille, John C.
*Ebbutt, Frank
*Frobberg, M. Hans
Griffiths, Gordon A.
Hewitt, D. F.
*Higgins, Larratt T.
Kelder, Sidney J.
*Labow, Larry F.

*Laird, Harry C.
*La Prairie, Leon
Lindsay, William R.
*McCarney, Carmel C.
McConnell, R. K., Jr.
Mitchell, J.
Morgan, G.
Parr, Theo M.
Patchett, Joseph E.
Ratcliffe, John H.
Reimers, Jan H.
Rodgers, C. Earl
Roscoe, H. L.
*Sharpstone, D. C.
*Smellie, Donald W.
*Stewart, C. H. E.
Templin, Morgan J.
Wansbrough, V. C.
*Watts, Murray
*Williams, R. Massey

TRENTON

B. W. Powers & Son, Ltd.
Alyea, O.

VIRGINIATOWN

Kerr-Addison Gold Mines
Beggs, Robert J.
Fredeen, Sture R.
Hawkes, Geo. J.
Yule, S. C.

WILLOWDALE

Electronic Detecting Devices
*Bjarnason, Bjarni S.
W. G. Wahl, Ltd.
*Wahl, William George
No Data Supplied
*Bronson, Edwin H.

WINDSOR

Ford Motor Co. of Canada
*Bonham, John C.

WOODBRIDGE

No Data Supplied
Healy, Ralph L.

WORTHINGTON

Aer Nickel Corp., Ltd.
Galloway, Walter F.

QUEBEC

ARVIDA

Aluminum Labs., Ltd.
Gummer, Wilfrid K.
No Data Supplied
Bouldin, Raymond

ASBESTOS

Canadian Johns Manville Co.,
Ltd.
*Borror, Chas. D.
Borror, Charles Donald, Jr.
Conn, H. K.
Lindell, Karl V.
Monroe, David L.
Straw, David J.
No Data Supplied
Eby, J. O.

BARRAUTE

Barvus Mines, Ltd.
Girvan, John M.

BLACK LAKE

Am. Smelt. & Refin. Co.
*Hollett, Allen B.
Lake Asbestos of Que., Ltd.
Edwards, Thos. R.
Messel, Michael J.
*Pluze, Lionel C.

BOURLAMAQUE

Dome Exploration Co.
Bambrick, Heber
Sigma Mines (Que.) Ltd.
Hartman, Robert J.

CHIBOUGAMAU

Campbell Chibougamau Mines,
Ltd.
Babcock, George H.
MacLean, Donald M.
Siscoe, S.
Chibougamau Assay Office
*Wilkie, Raymond Eric

GARDENVALE

Canadian Mining Journal
Mason, C.

North America-Mexico

HUDSON HEIGHTS

No Data Supplied
Grant, Gerald W.

ILE PERROT NORTH

No Data Supplied
Knowles, David M.
Roxburgh, Wm. H.

KILMAR

Canadian Refractories, Ltd.
Bray, William T.

LENNOXVILLE

No Data Supplied
Bladon, Leigh W.

McWATTERS

New Hosco Mines, Ltd.
Honking, Wm. J.

MONTREAL

Aluminium, Ltd.
Weigel, Melvin P.
Aluminium Co. of Canada
Hayes, C. W.
Smith, Warren S.
Turney, Arthur C.
Aluminium Laboratories, Ltd.
Hose, Heath Roydon
Patience, L. Patrick
Walker, W. J. K.
Aluminium Secretariat, Ltd.
Harder, E. C.
Atlas Copco Canada, Ltd.
Gummesson, S. Goran
Jacobsen, H. S.
Canada Cement Co., Ltd.
Hamilton, V. C.
Canadian Chemical Co., Ltd.
Ponessie, Thomas J.
Canadian Copper Refiners, Ltd.
Schloen, John H.
Canadian Industries, Ltd.
Ed, K. M.
Matthews, Fred W.
Canadian Ingersoll-Rand Co., Ltd.
Burbank, Herbert A.
Falconer, Duncan J.
Gillespie, A. G.
Wendeborn, R. D.
Canadian Inst. of Mining & Met.
Gerow, Carlyle
Canadian Refractories, Ltd.
Pitt, Norman P.
Canadian Shale Mining Corp.
Geoffroy, Paul R.
Canadian Vickers, Ltd.
Donaldson, J. W.
Dominion Brake Shoe Co.
Desrosiers, P. H.
Dominion Steel & Coal Corp.
Wygor, Rufus J.
Fairley, A. L., Jr.
Dorr-Oliver-Lomp, Ltd.
Hart, Harry F.
Hewitt Equip. Ltd.
Mills, G. B.
Hollinger-Hanna, Ltd.
McManus, C. E.
C. G. Huston & Assoc.
Bassermann, Robt. R.
H. J. Kaiser Co. (Canada) Ltd.
Wallach, Albert A.
McGill Univ.
Gleeson, C. F.
MacEwan, James U.
Morrison, R. G. K.
O'Neill, Dr. John J.
Mine Equipment Co., Ltd.
Clark, J. H.
Shipley, George W.
S. D. Miller & Sons
Miller, Alfred N.
Nat'l. Quarries, Ltd.
Yarberry, Lee M.
Pickands Mather & Co.
Harris, Donald G.
Kennedy, Bruce E.
Premier Iron Ores, Ltd.
Cavanagh, P. E.
Quebec Cartier Mining Co.
Coombes, W. K.
Huff, Virgil R.
Peterson, Jerome L.
Sveinson, Lloyd J.
Steel, J. S.
St. Laurence River Mines Ltd.
Riverin, Paul E.
Timmines, Ltd.
Armstrong, John
Timmines, Leo H.
Timminis, N. A., Ltd.
Weldon, Frederic E.
No Data Supplied
Brousseau, P. Jr.
Cohen, Julius M.
Dymont, A. E.
Fisher, Norman R.
Godard, J. S.

Kippen, W. Bruce
Krukar, Milan
Macaulay, R. M.
Moss, Frank A.
Rankin, D. M.
Retty, J. A.
Rogean, Hubert
Savard, Guy
Stevens, Robt. W.
Van Houten, Chas. N.
Woodhouse, C. H.

MURDOCHVILLE

Gaspé Copper Mines, Ltd.
Berube, Harty S.
Dworatzek, J. J.

NORANDA

Elder Mines, Ltd.
Honsberger, A. H.
Gardner Steel, Ltd.
Costa, John A.
Noranda Mines, Ltd.
Ames, H. Lyall
Anderson, J. N.
Ramsell, John Dennis
Quebec Mining Corp. Ltd.
Ballachey, A. G.
No Data Supplied
Grant, H. G.

NORVESTOS

No Data Supplied
Bourassa, Paul J.

OKA

Molybdenum Corp. of America
Bond, Stephen B.

PORT CARTIER

Que. Cartier Mining Co.
Grosz, Roland Ward

QUEBEC (CITY OF)

Laval University
Lefebvre, G.
Waddington, G. W.
Quebec Dept. of Mines
Dufresne, A. O.
Remick, Jerome H.
No Data Supplied
Ross, J. G.

ROUYN

Anaconda Co. (Canada) Ltd.
Ahrens, Ernst H.
Schaaf, Robert E.
No Data Supplied
Klama, Byako

SHEFFERVILLE

Iron Ore Co. of Canada
Campbell, Douglas Scott
Dufresne, Cyrille
Goldsmith, R. J.
Harries, D. R.
Nelder, John E.

SENNETERRE

Noranda Mines, Ltd.
Miller, Robert J. M.

SEVEN ISLANDS

Canadian Industries, Ltd.
Kiddier, Kendall
Iron Ore Co. of Canada
Farnam, H. E., Jr.
Moss, A. E.

SHAWINIGAN

Canadian Carborundum Co.
Hawn, A. Conrad

SHAWVILLE

Hilton Mines, Ltd.
Gerber, Harry G.
Halupka, H. A.

SHIGAWAKE WEST

No Data Supplied
Almond, Lloyd B.

SOREL

Que. Iron & Titanium Corp.
Noy, Jack M.

THETFORD MINES

Asbestos Corp., Ltd.
Foster, William H.
Jenkins, G. F.
Penhale, A. L.
Smith, John M.
Thurston, Frank E.

Flintkote Mines, Ltd.
Fairlie, Bertram M.
Johnsons Co., Ltd.
Mossop, John W.
Johnson, A. S.

VAL d'OR

Koulomzine & Brossard, Ltd.
Koulomzine, Theodore
Manitou Barvue Mines, Ltd.
Livingstone, David A.

WESTMOUNT

No Data Supplied
Vissac, Gus A.

SASKATCHEWAN

ELDORADO

Eldorado Mining & Ref., Ltd.
Marshall, K. T.
Tomlinson, H. S.
Pittson, Victor J.
Smith, Edgar E. N.
Woodward, Jack R.
No Data Supplied
Broersma, S.

ESTERHAZY

Int'l. Minerals & Chem. Corp.
(Canada) Ltd.
Lane, Robert H.
Signer, M. I., Jr.
No Data Supplied
Pickard, F. C.

REGINA

Imperial Oil Ltd.
Glover, H. R.
Dept. Mineral Res., Prov. Sask.
Kents, Paul

SASKATOON

Potash Co. of America, Ltd.
Murdoch, James D.
Roth, Edward F.
U.S. Borax & Chem. Corp.
Bruhn, Henry H.
No Data Supplied
Tyman, Paul M.

URANIUM CITY

Lorado Uranium Mine, Ltd.
Lendrum, F. C.
Gannar Mines, Ltd.
Stevens, Donald C.

YUKON TERRITORY

ELSA

United Keno Hill Mines, Ltd.
Wall, W. Arthur

WHITEHORSE

Canol Metal Mines, Ltd.
Field, W. E.
No Data Supplied
Christensen, A. K.
Hilchey, Gordon R.

MEXICO

BAJA, CALIFORNIA

Cia. Minera Santa Rosalia
Reynoso, L. Manuel
No Data Supplied
Garcia-Guaitanilla, F. L.

CHIHUAHUA

Amer. Smelt. & Refining Co.
Barajas, C.
Bossard, Gerald W.
Ehrlinger, Henry F., III
Evans, Thomas A.
Galvan Lopez, Joaquin
Goddard, Fred W.
Green, P. E.
Grenier, Arthur G.
Hinton, Geo. B.
Kipnis, Norman
Percival, Geo.
Peyton, F. K.
Snow, W. E.
Stringham, James R.
Williams, Albert B.
Cia. Minera Nacional, S. A.
Bush, C. Handman
Morales, Victor M.
Cia. Minera Penalta Sade
Adamec, Lew
El Potosi Mining Co.
Evans, Charles Edward
Horcasitas, Agustin S.
Nesbitt, Martin B.

The Fresnillo Co.
Keller, Howard F.
Sims, Walter S.
Wilson, Ivan F.
Minas de Iquala
Taylor, R. B.
San Francisco Mines of Mex.
Ltd.
Bacon, F. G.
Bluege, V. P.
Hanson, Henry B.
Rodriguez, Alfredo I.
Semmens, John W.
No Data Supplied
Arreola, C. V.
Brown, Philip
Brown, Ray
Fink, Wm. N.
Place, Adolf Edwin

COAHUILA

Altos Hornos De Mex., S.A.
De La Fuente, J. J.
Cia. Minera Julieta, S. A.
Siebert, Walter E., Jr.
Mazapil Copper Co.
McCarthy, John C.
Minera Rosalia S.A. de C.V.
Gonzalez, B. Leonides
No Data Supplied
Aguilar, Ruperto G.
Martinez, Baltazar

FEDERAL DIST.

Amer. Smelt. & Refin. Co.
Campbell, Charles W.
Garcia-Lozano, German
Sanford, Henry J.
Turu, Masaru
Yeager, A. Joseph
Armco Mexicana
Holgún, Carlos Chavez
Atlas De Mexico, S.A.
Avila T., S.
Zahnow, C. F.
Azufra Panamericana, S.A.
Jaquet, Harold H.
Terrones L., A. J.
Chi. Pneumatic Tool
Briceno, Roberto G.
Cia. Exploradora Del Istmo
Mason, Edward O.
Guiza, Reinaldo, Jr.
Cia. Hulera Euzkadi
Ball, Donald A.
Cia. Mex. De Explosivos, S.A.
Loretta, Frank B.
Cia. Minera De Penoles, S.A.
Acon, Ernesto
Cia. Minera Ina, S.A.
Gandara Garcia, J. J.
Cia. Minera Kenmex, S.A.
Aguilar, Gustavo
Ulloa, Salvador
Ordóñez, Georges
Pantoja, Jerjes
Comisión de Fomento Minero
Treviso, Salvador F.
Cyanamid De Mexico, S.A.
Fitzsimmons, W. M.
Denver Equipment Co., S.A.
McGrath, J. M.
Depto. Tecnológico de Minería
Himmelman, A. Carlos
Albert Doerr Co., S.A.
Doerr, Karl F.
Dresser International Inc.
Gaines, Richard V.
Du Font, S.A. de C.V.
Chavez, Oscar H.
Schiele, Wm. R.
Empresas Unidas, S.A.
Carty, John T.
The Fresnillo Co.
Carswell, John M.
Rose, Hugh
Villasenor, Luis S.
Hoynd-Fagersta Acero's
Da Costa, E. A.
Instituto de Geología
Fries, Carl, Jr.
Internatl. Coop. Admin. USOA
Miller, Ralph L.
Miller, Ralph L.
Joy Sullivan Machinery Co.
Eberstadt, R. H.
Mexico Atomic Com.
Fernandez, Mario
Mexican Government
Pena, Salvador
Minas De Bernal, S.A.
Seamon, W. H.
Minera De Mercurio
Rodriguez, F. H.
Ruiz Ocampo, Julio
Thomas M. Nevins y Cia., S.A.
Nevin, Thomas M.
Petroleos Mexicanas
Gonzalez-Reyna, Jenaro
U.S. Bureau of Mines
Potter, George M.
Vaupell y Garcia
Garcia, Jose A.
Vaupell, C. W.

No Data Supplied
Bolland, Juan P.
Bolton, H. E.
Bonillas, Ygnacio S.
Booth, D. M.
Obregon, S. Cortes
Creel, Luis J.
Darde, F. Jean
De Murga, Alvaro
Edelen, A. W.
Vasquez, G. Gallardo
Hardy, J. K.
Johnson, Robert W.
Llamas, Raymundo C.
Madero, Enrique
Mosonyi, Emil
Nieto, Jorge C.
Rhodes, W. B.
Roel, F.
Roldan, David G.
Romero-Luna, F.
Sarrell, W. H.
Schroeder, L. C.
Serrano, Gustavo P.
Shedwick, William J., Jr.
Shelton, Derek C.
Tapia T., Roberto
Terrazas, Alfredo
Valdes, E. G. Y.
Veytia, M.
Villafana, B. M.
Vinegra, F. O.
Von Ziegler, E.
Von Ziegler, F. G.
Yanez, J. R.
Zironi, Francis V.

DURANGO

Cerro De Mercado
Maldonado, Carlos F.
Cia. Mexicana de Explosivos
McLaughlin, J. Frank
Easter, Robert J.
Cia. Minera El Trebol, S.A.
Behrens, B. Howard
Cia. Minera de Penoles, S.A.
Savage, John P.
San Luis Mining Co.
Benham, Willard M.
Cooper, James R.
Guzman Carreon, Luis
Morel, Robert C.
Richardson, Peter W.
Williams, Stanley E.
No Data Supplied
Neumann, G. W.
Reyes, J. M. S.
Welsh, M. J.

GUANAJUATO

No Data Supplied
Sproat, A. D.

GUERRERO

Amer. Smelt. & Ref. Co.
Foster, Earl F.
Cia. Min. Nacional
Robles, Manuel A.

ESTADO DE MEXICO

Mexicana de Minas Berresicos, S.A.
Ground, Ernest R.
No Data Supplied
Jarvis, Royal P.

HIDALGO

Cia. De Real Del Monte
Morgan, Wm. M.
No Data Supplied
Corbett, Francis X.
Peabody, G. R.

JALISCO

Cia. Minera Autlan, S.A.
Calvillo T., Manuel
Impulsora Metallurgica
Matusewicz, A.
No Data Supplied
Adams, Malcolm M.
Madero, Enrique, Jr.
Wasteneys, G. M.

MARELOS

No Data Supplied
Sopria, Robley F.
Woodul, J. R.

NUEVO LEON

Cia. Minera de Pinos, S.A.
Barrera, A. Lopez
Dulles, John W. F.
Haas, Maurice C.
Malcolm, John B.
Rheinheimer, O. C.
Sanchez-Mejorada, P.
Williams, C. T.
Cia. Minera Nuevo Leon, S.A.
Prado, Jose Jesus

Fundidora De Fierro
 Villamar, Salvador
 Las Encinas, S.A.
 Camelo G., Felipe
 Miquim Internacionales, S.A.
 *Cohen, Henry R.
 Zinc Nacional, S.A.
 Villareal, E. M., Jr.
 No Data Supplied
 Garcia, S. S.
 Jauregui, J. A.
 *Salisbury, Earl F.
 Sauza, Javier
 Schaefer, Ronald W.
 *Triplett, Walter H.

OAXACA

No Data Supplied
 Seaman, W. A.

SAN LUIS POTOSI

Amer. Smetl. & Ref.
 Herrington, Ellis B., Jr.
 Maese, Arthur J.
 Salmi, G. J.
 Minerales Pennsalt, S.A.
 *Cutting, P. J.

SINALOA

Amer. Smelting & Ref. Co.
 Amis, Cecil Rhodes
 Pickard, G. W., Jr.
 Slessinger, L. J.
 Chico Villaseñor, Enrique
 Wilhelm, Fred A.
 San Luis Mining Co.
 Bissett, D. H.
 Morel, Lawrence F.
 No Data Supplied
 Hanger, Anders

SONORA

Cananea Cons. Copper Co.
 Feun, A. J.
 Fuller, Edward P., Jr.
 MacIntosh, John C., Jr.
 *Mendelsohn, Albert
 Montijo H., Fernando
 Morris, George E.
 Stern, Roger
 *Ruff, Arthur W.
 Tye, William H.
 Velasco, J. Ruben
 *Weed, Robert C.
 Cia. Minera Ben Wilco
 Williams, Ben F.
 Cia. Minera de San Jose
 *Lord, William D., Jr.
 Flouresqueda, S.A.
 *Robinson, L. M.
 Grañera De Sonora, S.A.
 Hammond, A. Horton
 Minera Mexicana, S.A.
 *Fields, Howard H.
 Montezuma Copper Co.
 Ramos, Miguel O.
 Refin. De Tungsteno, S.A.
 *Price, Robert W.
 No Data Supplied
 Friesen, Roy M.
 Quiroga, Manuel F.
 No Data Supplied
 Taylor, Melvin H.

VERA CRUZ

Cia. Explor. Del Istmo, S.A.
 Bustos, G. A.
 Pan-American Sulphur Co.
 Semrad, Robert

ZACATECAS

Cia. Met. Mex. ASARCO
 Botzén, Donald W.
 Hannan, H.
 Cia. Minera De Penoles, S.A.
 Durfee, Jay W.
 Engstrom, John A.
 McCabe, Robert R.
 Peck, De Witt C., Jr.
 The Fresnillo Co.
 Anderson, Richard C.
 Bailey, Fred W.
 Schou, Hans H.
 Stone, John B.
 Veale, Charles J.
 Walsh, F. H.
 *Wishaw, Quentin G.
 Minera San Mateo
 Kohl, Albert E.
 No Data Supplied
 Mandersfield, Edward A.
 Reyes, Juan

CENTRAL AMERICA

COSTA RICA

Alcoa de Costa Rica, Inc.
 Stouffer, Harold W.

Legacion de Holanda
 Zijdeveld, Pieter Hendrik

EL SALVADOR

No Data Supplied
 Levy Enrique

GUATEMALA

Comp. Minera de Guatemala
 Probert, Alan
 Cia. Minera Huehueten
 Cisneros, Vicente
 MacPhee, William R.
 Grace & Co.
 Hathbourn, C. C.
 U.S. Bureau of Public Roads
 *Scott, Lewis E.
 No Data Supplied
 Burke, Robert L.
 Corzelius, C. E.
 Tufts, John M., Jr.

HONDURAS

Cia. Minera Los Angeles
 Cope, Louis W.
 New York Honduras Rosario
 Ming, Co.
 Morris, William Pierce
 Tela Railroad Co.
 Lane, E. C., Jr.
 Utex Explor. Co.
 *Haynes, John F.
 No Data Supplied
 Emdin, H. J.
 Knight, E. T.
 Robinson, H. R.
 Stott, Geo. F.
 Van Schaack, Peter

NICARAGUA

Cia. Minera La India
 Spencer, Donald N.
 Empresa Minera De Noga
 Almazan, C.
 Mina Santa Rosa
 Anderson, T. M.
 La Luz Mines, Ltd.
 De Voogd, N.
 Kentish, N. Norman
 Molina A., Eduardo
 *Piechak, John
 Neptune Gold Min. Co.
 Aguirre, Luis H.
 *Burton, Robert S.
 Concoran, T. A., Jr.
 McCullough, W. S.
 Schuring, Henry G.
 No Data Supplied
 Willey, J. A.

PANAMA CANAL ZONE

BALBOA

No Data Supplied
 Hurtado, Julio E.

CRISTOBAL

No Data Supplied
 Christoph, Vern H.

REPUBLIC OF PANAMA

No Data Supplied
 Leonard, Donald J.

WEST INDIES

CUBA

HAVANA

Banco de Fum. Agric. E. Ind.
 Castro, Carlos
 Comp. Min. Buenavista
 *Montoulier, Eduardo I.
 Ingersoll-Rand de Cuba
 Garriga, Jose R.
 Minera Moa
 *Vidal, Francisco F.
 Moa Bay Min. Co.
 Colligan, Richard V.
 Observatorio D Colegio
 Goberna S. J., Jos. R.
 U.S. Bur. of Mines
 Keyes, William F.
 No Data Supplied
 *Ruiz Williams, Enrique J.
 Trotter, Felix F.
 *Wandke, Alfred D.

MATAHAMBRE

Minas de Matahambre
 Lleras, David F.
 Nelson, Arthur P.

MOA BAY

Moa Bay Min. Co.
 Engle, Lester F.
 Wakeman, John S.

NICARO

Cuban Nickel Co.
 Harris, Charles V.
 Nickel Process Corp.
 Albertson, Floyd E.
 Mitchell, J. Stanley
 Thornton, F. R.
 Willey, Richard H.
 No Data Supplied
 Soler, Darwin

SANTIAGO

Minera Imperial
 *Cooper, Edward N., Jr.
 Moa Bay Min. Co.
 Darnell, Balfour F.
 Kristjansson, Harold G.
 Schüssler, John H., Jr.
 Univ. De Oriente
 Suft, Stanley J.
 No Data Supplied
 Soto Bucarely, L. B.

DOMINICAN REPUBLIC

BARAHONA

Bestwell Gypsum Internl.
 Merriss, Philip R.

CIUDAD TROJILLO

Alcoa Explor. Co.
 Van Blyenburgh, John

LA ROMANA

Central Romana Corp.
 *Strong, Philip K.

HAITI

MIRAGOANE

Reynolds Haitian Mines
 Ryan, E. J.

PORT AU PRINCE

Soc. D Explor. et de Dev.
 Frank, V. E.
 No Data Supplied
 O'Donnell, Keith

JAMAICA, B. W. I.

KINGSTON

Jamaica Gypsum Ltd.
 Connert, R. P.

LYFORD

Reynolds Jamaica Mines
 Cole, Wm. S., Jr.
 Williams, R. H.

SPURTREE

Kaiser Bauxite Co.
 Clary, John H.
 Lallman, M. W.
 Lee, Walter
 Muller, L. Frederic
 Phillips, Chas S.
 Timberlake, R. C.
 No Data Supplied
 Tretzel, D. C.

WILLIAMSFIELD

Aluminum Jamaica Ltd.
 Lilliecap, D. H.

PUERTO RICO

No Data Supplied
 St. Clair, John Q.

TRINIDAD

PORT OF SPAIN

Baryle & Mineras
 Gerling, R. W.
 Neal & Massy Engrg. Ltd.
 Massy, Charles R.

SOUTH AMERICA

ARGENTINA

BUENOS AIRES

G. Breuer
 Guerrero, Martin
 Banco Industrial de la R. A.
 *Conti, Luis
 Cia Minera Aguilar S. A.
 Lew, Wing L.
 Miller, Clinton L.
 Ind. Argen. de Aceros S.A.
 Acevedo, Arturo
 Minerals y Met. S. A. I. C.
 Tolderlund, Otto
 National Lead Co. S.A.
 Bryan, G. Gregory
 Worcester, John
 Nat'l Univ. of Buenos Aires
 *Stoll, Walter C.
 Sommar, Sociedad Minera
 Argentina S.A.
 Burnett, Bruce R.
 Williams, Thomas J.
 No Data Supplied
 Ellinger, Enrique
 Perichon, Luis A.
 Vila, F.

ENTRE RIOS

No Data Supplied
 Soldini, J. R.

JUJUY

Cia Minera Aguilar S.A.
 Milan, J.
 Rossetti, Marco J.
 Steele, Robert

MENDOZA

No Data Supplied
 Monchablon, Alberto

ROSARIO

No Data Supplied
 Werner, Hans R.

SAN JUAN

Cia Minera Castano Viego
 Stewart, Thomas A.
 Univ. of Cuyo
 *Ruiz Bates, Ramon

SAN LUIS

Facultad de Ciencias U.N.C.
 *Rossi del Cerro, Ernesto E.

SAN NICOLAS

Siderurgica Argentina
 Byrns, H. A.

BOLIVIA

ATOCHA-QUECHILJA

Empresia Minera Quechilja
 Alondia B, Julio

CATAVI

Empresia Minera Catavi
 *Davila, M. Oscar
 No Data Supplied
 Antezana, Carlos J.

COCHABAMBA

Bolivian Gulf Oil Co.
 Coughlin, Robert E.
 Emp. Min. Santa Maria Ltd.
 Holme, Percy E.
 Western Geophys. Co. of
 America
 Lus, Louis M.

LA PAZ

Caparacion Minera de Bolivia
 *Lubinski, Boris V.
 Fabulosa Mines Cons.
 Dorn, Basil
 Ford, Bacon & Davis Inc.
 Walsh, Myles A.
 Intl. Ming. Co.
 *Campusano, S., German
 S. A. Placers Inc.
 *Leeson, Grant
 United Nations T.A.A.
 Gratacap, Maurice
 No Data Supplied
 Barbour, Gordon
 Broerema, Goosen
 Haighton, A.
 Lusney, John E.
 Daza, Luis Murillo
 Sarmiento, M. E.
 Zubraycki, Piotr P.

Mexico-Brazil

LLALLAGUA

Oficina Geologica
 Meyer, H.
 No Data Supplied
 Wiekilinski, S.

ORURO

Corp. Minera de Bolivia
 Echalar, Alberto
 Empresa Minera Colquiri
 Kooman, J.

POTOSI

Emusa
 Dorado, Waldo Reyes

TUPIZA

Ford, Bacon & Davis Inc.
 De Ferrari, Clyde F.

BRAZIL

BELEM

Industria e Comercio de
 Minerios S.A.
 Appel, Luiz E.
 Figueiredo, Enie D.
 Flynn, Alex J., Jr.
 Nagell, Raymond H.
 Penido, Guido D.
 Kaiser Alum. Ltd.
 Towse, Donald F.
 No Data Supplied
 Butler, Robt. D.
 Flesham, Howard G.
 Reed, W. F.
 Roberts, Walter D.
 Sears, Antonio C.
 Sydenstricker, D. G.
 Whitehead, Gilbert

BELO HORIZONTE

Miner. Hannaco, Ltd.
 Dean, Peter W.

CURRAIS NOVAS

Mina Barra Verde
 Thomas, A. M.
 Mineracao Wah Chang S.A.
 Fisher, Donald G.
 Miskulin, Mike G.
 No Data Supplied
 Gardner, Geo. D.
 Pimentel, Victor J.

MINAS GERAIS

Mineracao Hannaco Ltda.
 Hurley, Nick J.
 Erasmus, M. G.
 St. John del Rey Min. Co.
 Kochersperger, Donald
 No Data Supplied
 Walker, I. A.

RIO DE JANEIRO

American Embassy
 Brown, Emerson I.
 Cia Auxiliar
 *Fleming, Russell C.
 Cia Codim
 Claus, Richard J.
 Cia Meridional de Mineracao
 Knowles, D. F.
 Russell, C. B.
 Du Pont Do Brasil S.A.
 Margraf, Oscar E.
 Geoprosco Brasil S.A.
 *Campbell, Donald F.
 Kendrandia Pesquisas Mineras
 S.A.
 Woodson-Hartman, Louis
 Wm. H. Muller, S.A.
 *Van Nordheim, Rud.
 No Data Supplied
 Clement, Wilbur M.
 De Sousa, H. C. Alves
 Erickson, Eugene P.
 Pinagel, Hubert A.

SALVADOR

Curso de Geol. Fac. de Felo.
 Humphrey, Fred L.
 Curso de Geol. Petr.
 Mattoso, S. De O.
 Petre Tech. Serv. C.A.
 Gardner, A. M.
 United Geophysical
 Warren, Jack R.

SANTO ANTONIO DE JESUS

Cia Minas da Bahia
 Kapadia, Adi Homi

Brazil-Peru

SAO PAULO

Acumuladores Prest-O-Lite
Jewitt, W.
Univ. de Sao Paulo
Franco, R. R.
No Data Supplied
Jafet, Roberto N.
Loeb, Michel J.
Martinielli, Jose A.
Moreas, Jose E.
Guimaraes, J. Passos
Walker, W. S.

SIDERAPOLIS

Cia Siderurgica Nat'l.
McKim, J.

BRITISH GUIANA

GEORGETOWN

Central Guiana Explor.
Schindler, P. E.
Demerara Bauxite Co., Ltd.
Campbell, James G.
Reynolds Metals Co.
Bartlett, C. E.
Baumgardner, L. H.

KWAKWANI

Reynolds Metals Co.
*Petrick, Alfred, Jr.
Reynolds Min. Corp.
Devlin, Robert

CHILE

ANTOFAGASTA

Anglo-Lawtaro Nitrate Corp.
Spencer, Cyril L.
Strong, Charles N.
Caja de Credito y Fomento
Minero
*Escalera, Marcelo C.
Empresa Minera de Mantos
Blancos S.A.
Dawidowicz, S.
Meckel, Walter F.
Vince, P. M.
Mauricio Hochschild Co.
Joseph, Werner O.
Wendel, Clifford

CHANARAI

Andes Copper Min. Co.
Wiseman, B. I.

CHUQUICAMATA

Chile Exploration Co.
Allen, Joseph C.
Becker, Robert C.
Biegman, K. A.
Boase, J. Warren
Brewer, William A. III
Bruna, Horacio A.
Hamilton, Robt. L.
Henderson, Harry B.
Hodges, Paul A.
Kazmierski, Harry M. M.
Laurich, Robert
Marcus, Jerrold J.
Mayer, Franz L.
Payne, Richard F.
Price, Jas. H.
Randall, Robert
Rudolph, Wm. Edw.
Sanders, David Scott
Swayne, William H.
Swift, R. G.
Teel, Joel H.
Vallez, Michael H.
Witcomb, E. W.
Wyman, G. S.

COPIAPO

Cia Min. y Com. Salí Hochschild S. A.
Cossoro, Moll Carlos

EL SALVADOR

Andes Copper Min. Co.
Canning, Brian F.
Cole, Allan A.
Leonard, Charles B.

LA CRUZ

No Data Supplied
Bowers, C. G.

LA SERENA

Bethlem Chile Iron Mines Co.
Krumm, B. R.
Petersen, E. F., Jr.

POTREILLOS

Andes Copper Min. Co.
Aldous, Philip Kenyon
Aslett, Harry
Bates, W. A.
Beall, John V.
Delzo, Jorge Rojas
Fines, Leonard O.
Hobbs, Peter B.
Nicholson, David E.
Parker, Greg V.
Pollish, Lloyd
Robbins, Harold E.
Trafton, Berl A.
Wendt, Walter
Wheeler, E. W.

QUILPUE

No Data Supplied
Crichton, Juan E.

RANCAGUA

Braden Copper Co.
Babson, Thomas J.
Bacon, Robert C.
Bosko, Guido
Eisner, Thomas M.
Gadberry, James W.
Grant, Byron E.
Howell, Fred H.
*Jarrett, Stanley M.
Jiggins, R. W.
Molloy, John S.
Morales, J. Quiroga
Niedermeyer, O. David, Jr.
Warren, Norman F.

SAN FELIPE

No Data Supplied
Jimenez, E. Hagel

SANTIAGO

Cerro de Pasco Corp.
James, Robert C.
Knox, James Donald
Sheppard, J. J.
Cia Amer. Smeltg. S. A.
Brown, Wendell T.
Wise, Francis A.
Cia Sud Amer. De Explosivos
*Sobral, Daniel M.
Compania de Acero del Pacifico S.A.
Gondouneau, Pablo
Compania Minera Los Maquis
Mackenna, Francisco
Cuevas
Fabrica Nacl de Carburo y Metallurgy
Echeverria, Vicente
Ingersoll-Rand Co.
Fleming, Charles W.
Sosteda Minera Andromeda Ltd.
*Nomura, Eichi
U. S. Embassy
Carter, W. D.
Kowles, Paul H.
No Data Supplied
Arancibia, Nemesio
Benitez, Fernando
Goldmann, L.
Haldeman, Robt. M.
Hornkohl, Herbert
Judson, W. R.
Munoz, Ernesto
Swain, Robert L.
Van Dorp, J. F.

TALCAHUANO

Compania de Acero del Pacifico
*Waissbluth, Gregorio

VALLENAR

No Data Supplied
*Cook, Wilbur John

COLOMBIA

BARRANQUILLA

No Data Supplied
Barraza O., B.

BOGOTA

Intl. Petro Co., Ltd.
Glenn, Sidney E., Jr.
No Data Supplied
*Aisenberg, Victor
Fracken, R. B.
Martinez, Evaristo
Prieto, Joaquin A.

CALE

Compania Minera Choco
Pacifico S.A.
*Azzaretti, Frank J.
Burke, Michael A.
Farfet, Henry B.
Rumpf, Vincent G.

EL BAGRE

Fato Cons. Gold Dredging, Ltd.
Eastman, J. H.

EL CENTRO

Forest Colombian Corp.
Douglass, Fred D.

HONDA

No Data Supplied
Crease, H. H.

MANIZALES

No Data Supplied
Jaramillo, Bernardo

MEDELLIN

Cia Minera Choco Pacifico S.A.
Barber, Leon F.
No Data Supplied
De Bedout, Dario
Geale, George J.
Hill, G. Beni.
De Lac Posada, Juan
*Von Staufen, Hubert

OTU VIA MEDELLIN

Frontino Gold Mines, Ltd.
Wood, Wm. Bourne
Baker, John F.
Brownhill, Herman F.
McPhee, Roland

PASTO

C M de N
Lombardo, Louis P.

SEGOVIA VIA MEDELLIN

Frontino Gold Mines Ltd.
Camposano, Gustavo
Leidhold, Helmut

ECUADOR

GUAYAQUIL

Ecuadorian Corp. Ltd.
Gray, Latham B.

QUITO

I. A. G. S.
Colvocoresses, Alden P.
Utah International Inc.
Pollin W. J.

FRENCH GUIANA

CAYENNE

No Data Supplied
Jaffe, Felice C.

PERU

AREQUIPA

Compania de Minas del Peru
Barrantes-Garate, E. T.
Compania Minera Condoroma, S.A.
Heard, H. T.
Lampa Mining Co. Ltd.
Curtis, Cecil Basil
No Data Supplied
Davidsch, Rudi
Lulland, F. G.
Williams, A. Howell

CASAPALCA

Cerro de Pasco Corp.
Chrzanowski, T.
Lavin, J. W.
Lizarraga, Luis H.

CERRO DE PASCO

Cerro de Pasco Corp.
Anderson, John M.
Diaz-Chavez, Javier
Foote, Kay W.
Fretz, Ray C.

Randall, Frank M.
Phendler, Roy W.
Cia Minera Atacocha
Bautista, F.
Belon, E. Torres

CHACACAYO

No Data Supplied
Craig, Glenn E.

CHUQUIBAMBILLA

No Data Supplied
Billwiller, C. J.

HUANCAYO

Minas Cercapuquio S.A.
Chaman V., Francisco
Flores, C. P.
No Data Supplied
Alfaro, Carlos O.

LIMA

Cia Administradora De Minas S.A.
*Fleischman, Cyril L.
*Rosenshine, Leon James
Armo Peruana, S.A.
Cumpston, G. S. W.
Banco Minero Del Peru
*Diaz Dulanto, Oscar
*Labarthe, Hernando
*Portaro, Pedro
Stens, Alfredo G.
*Tasaico-Ore, N.
Vigil, J. A.
Capitana Gold Mines Co.
Manchuriz M., A.
Castrovirreyna Metal Mines Co.
Lewis, Rachal H., Jr.
Russell Clyde R.
Cerro de Pasco Corp.
Barrios, A. H.
Garcia, Marcial
King, N. E.
Kuryla, M. A.
Lee, William G.
Moser, H. J.
Smith, Julian D.
Wolfe, Karl
Cyanamid International
*Rojas, Tomas E.
Denver Equipment Co. S.A.
*Laman, Arthur C., Jr.
Cie Des Mines Huaron
Garrigue, Pierre
Diamantina-Diam. Drlrs.
*Boza, Jorge H.
Dorr-Oliver Inc.
Hall, Herbert W.
Grace y Cia
*Alvarez-Calderon, R.
Guillermo
Mauricio Hochschild & Cia
*Holme, R. Norman
*Knobler, Richard R.
Inca Mining & Dev. Co.
*Woods, Clarence Lee
Ingersoll-Rand Co. y Peru
*Avery, Don
Olson, Albert George
*Zehr, Norman R.
Inspiration Cons. Copper
Hara, Harold J.
International Mach. Co.
Del Carpio Z., A.
Jan Luis Gold Mines Co.
Thomas, Romilly
Christopher
Joy Mfr. Co. S.A.
Coats, S. Floyd, Jr.
Latin American Mines Ltd.
Birkbeck, J. M.
*Rose, Erwin
Marcona Mining Co.
Cabrera, Victor R.
Englund, J. O.
Salberg, Richard I.
Terry, Richard L.
Thurlow, Ernest E.
Minas De Venturosa, S.A.
Briceno, Luis F.
Cia Miner Santander Inc.
Wentworth, W.
Compania Minera Atacocha, S.A.
Portaro, Edgardo
Comp. Minera Tarica S.A.
Erquiga, R.
Cia Minera Milpo
*Baertl, Ernesto A.
Cia Mineta Palca
Samame, Mario
Morrison Knudsen Del Peru
Jones, Erwin Beck
Univ. Nacional de Ingenieria
*Ayza, Juan
Northern Peru Mining Corp.
Entwistle, Lawson P.
Reilly, John G.
Peruvian Dept. Public Wks.
Panizo, Jose V.
Peruvian Gulf Oil Co.
Keppel, David

C. H. Plenge Ore Test Lab.
*Plenge, Carlos H.
Refractarios Peruanos, S.A.
McCracken, William Henry
Servicios Petroleros, S.A.
*Farfet, Stanley W.
Sociedad Minas de Huachara
*Zuniga y Guzman, Emilio
Soc. Min. Punguio Cocha
*Brazzini, Alberto
Southern Peru Copper Corp.
Immonen, L. G.
Muse, Robert Bruce
Smith, Warren T.
Texas Petroleum Co.
Robbins, Raymond K.
G. E. Unger Ingenieros Assoc. S.A.
*Tarnawiecki, A.
U. S. Atomic Energy Comm.
Gabelman, John W.
U. S. Bureau of Mines
Spencer, Richard N.
Volcan Mines Co.
McCrory, Fred J.
Wells Overseas Ltd.
Graadt Van Roggen, A. H. F.
*Howard-Goldsmith, R. C.
McHarg, Norman S.
No Data Supplied
Aguila, Herman D.
Alexander, Roy K.
Angulo S., C.
Ballon, A.
Beard, B. R.
Belon, Enrique T.
Benavides, A.
Benedict, Ralph E.
Bernstein, Merwin
Doza, Hector J.
Chian, Augusto
Da Silva, Alfonso G.
*De Las Casas, Fernando
Dym, K. A.
Co Elmore, Ismael
Fernandini C., E.
Ferreiros, Ernesto
Funereau, Enrique R.
Galvan, Carlos
Graff, E. H.
Guillermo, G. D.
Horna, Eliseo
Jaime F., Cesar
Kochler, H. J.
Larrabure, Eugene
Lilley, W. L.
De Mola, C. T. Loret
Martonyi, Fred J.
Mastrovich, J. J.
McGraw, C. E.
Milligan, A. W.
Miranda V., L. A.
Moreno, P. H.
Muniz, Pedro E.
*Nogales, Luis A.
Obradovic, M.
Othick, J. R.
Rizo-Patron R., A.
Seery, Major W.
Dominguez-Sotomayor, Pedro
Stevenson, F. B.
Tapia, Carlos R.
Trego, H. E.
Venegas, A. F.
Vidal, Elmer

MIRAFLORES

No Data Supplied
Pautrat, Millosa
Philpott, W. J.

LA OROYA

Cerro de Pasco Corp.
Arguedas, J.
Bemis, Reg
Clarke, Charles D.
*Flores C., Julio Emiliano
Gerbrach, Fred P.
Hood, S. R. R.
Lehto, Robert S.
McKay, Cameron E.
Mittin, J. Gary
Quintana S., Jorge
Roggero, Carlos E.
*Scott, Derek
Van Der Poel, Arle Antonio
*Zevallos, Hipolito
No Data Supplied
Robles, J. V.

MOROCOCHA

Cerro de Pasco Corp.
Guggenheimer, Walter R.
Rojas M., Damaso
Schenk, James C.

PACASMAYO

Northern Peru Mining Corp.
Devaux, J. V.
Goodman, L. O., Jr.
Morton, Walter F.
Reed, Sam H., Jr.
American Smelt. & Ref. Co.
Hollister, Victor F.
Wickham, James F.
No Data Supplied
Latorre, Hugo Jaen

PUNA

Minas San Antonio De Eso
Hamilton, B. J. F.
Cia Minera Independencia
Palacios, Virgilio

SANTA LUCIA

Lampa Mining Co. Ltd.
*Pollandt, Fred

TACNA

Southern Peru Copper Corp.
Barua R., Victor
Campbell, G. E.
Johnson, Kenneth R.
Pope, Charles B.
Rusk, Albert T.
No Data Supplied
Brindle, Harry M.
Smith, W. Ferrin

TRUJILLO

Northern Peru Mining Corp.
Barron, F. A.
Clark, William G.
Stein, Hans H.
No Data Supplied
Roos, Karel

YAURICOCHA

Cerro De Pasco Corp.
Brown, Lester R., Jr.
Boswell, Paul F.
Quinones, L. A.

SURINAME

MOENGO

No Data Supplied
Guilford, J. D. S.

PARAMARIBO

Sural Co.
Lampert, John W.
Pappas, Hercules
Valkenhoff, J. H.
No Data Supplied
*De Greve, I. R. J.
Doeve, G.
Wright, Thomas L.

VENEZUELA

CARACAS

Baritina De Venezuela S.A.
Leonard, Morgan
C. A. Crolla Minera y
Metalurgica
*Von Kanicky, Leopold M.
Creole Petr. Corp.
Austin, Wm. A., Jr.
Trump, George W.
K. F. Dallmus & H. W.
Thoms
*Thoms, H. W.
Direccion de Minas
Pelaez, Eduardo
Explotaciones y Minas
*Kobler, Helmut G.
Gahagan Dredging Co.
*Cinco, Lupo F.
Ingersoll-Rand Co.
*Cunningham, P. J.
Inst. Venezolano de
Petroquimica
*Baez, Luis Manuel
Iron Mines Co. of Venezuela
Storms, Frank H.
Misea
*De Sola, Oswaldo
Mobil Oil de Venezuela
Conrad, P. P.
Hernandez, John Richard
Mesigas, M. G.
Ramseyer & Miller
Tatman, John L.
United Geolphys Co.
Golding, Charles L.

Univ. Central de Venezuela
Kroboth, Alfonso
Venezuelan Atlantic Rfng. Co.
Douglass, John H.
Venezuelan Caribbean S.A.
Rott, Edward H.
Venezuelan Sun Oil Co.
Young, Herbert A.
No Data Supplied
Aguerrevere, P. I.
*Aguilera, Luis
Dismukes, N.B.
Fekete, L. A.
Freeman, Carlos A.
Lopez, Victor M.
*Luchinger, F.
Machado, G. M.
Nevins, Peter T.
Olson, R. C., Jr.
Rosales, Cesar M.
Sorensen, R. C.
Tello B., Manuel

EL TIGRE

Cia Constructors Nona, S.A.
Davila, A.

GUIRIA

Iron Mines of Venezuela
Jimenez, Walfrido A.

LAGUNILLAS

Creole Petroleum Corp.
Ritter, John Robert

MARACAIBO

Cia Shell De Venezuela
Lee, R. L.
Neilson, J.
Westinghouse Venezolana
Fellence, C. A.
Creole Pet Corp.
Foley, Edward J.
Scanlon, Felix C.

MATURIN

Creole Petroleum Corp.
Sweeney, Matthew E.

PUERTO ORDAZ

Orinoco Mining Co.
Aiken, G. E.
Bleser, Philip D.
Burdan, Robert M.
Cole, James E.
Hendershot, Frederick V.
Hollensteiner, J. P.
Jackson, Wayne D.
Jones, Robert M.
Van Meter, Wm. S., Jr.
Wright, Frederick W., Jr.

SAN FELIX

Iron Mines Co. of Venezuela
*Aashe, Herbert John
Guth, Richard E.
Jackson, Earl E.
Shingler, Wm. H.
Wright, Samuel I.
Yancey, Leonard C.

TIA JUANA

Creole Petroleum Corp.
Bell, Earl Jennings
Noel, James A.

TANAQUILLO

Amveco, C. A.
*Brown, Leroy T.

EUROPE

AUSTRIA

CARINTHIA
Osterr Am Magnesit Ag
Awerzger, A.
SALZBURG
Kupferbergbau Mitterberg
Mazcek, Max

BELGIUM

BRUSSELS
Centre D'Information Du
Cobalt
Van Vinckerooy, Victor
Cie Royal Asturienne
Lamarache, Alfred

Bermia

*Evrand, Pierre
S.A. Mines Minerals et Metall.
*Lamouline, E. L.
Solvayetie
Boel, Rene G.
Union Min. Du Haut Katanga
Quets, Jerome Michel
Terwagne, Richard
Veroussen, J. A. C.
No Data Supplied
De Smaele, A.
Jacques, M. F.
Olbrechts, P. J.
*Raick, Julin O. M.

EISDEN

Charbonnages Limbourg Meuse
Hosdain, Michel

GHENT

Univ. of Ghent
De Witte, Georges

HEVERLE

Univ. of Louvain
*De Cuyper, Jacques A.

LIEGE

S.A. De Rothem
*Du Boullay, Vincent
S.A. Esperance-Longdoz
Le Paige, Ulrich

DENMARK

ESBJERG

No Data Supplied
Jepsen, I. L. B.

EIRE

AVOCA

St. Patrick's Copper Mines
Blazewicz, K.
*Corey, I. Ross

BALLISODARE

New Abbeystown Mining
Co. Ltd.
Mackenzie, Gordon B.

CORNAGEEHA

No Data Supplied
Jennings, A. G.

DUBLIN

S. McCormick Ltd.
McCormick, Sam
No Data Supplied
Creedon, C. J.

FINLAND

HELSINGFORS

Vuokseniska Co.
*Lupander, Kurt

HELSINKI

Inst. of Tech. Helsinki
*Mikkola, Aimo K.
Outokumpu Oy
Tanner, Heikki
No Data Supplied
Hukki, Risto T.
Majjala, Paavo

KAIVOS

Outokumpu Oy
Turunen, Eero

OTANIEMI

Suomen Malmi Oy
Raja-Halli, M.

OTANMAKI

Otanmaki Co.
*Runolinn, Urmas

OUTOKUMPU

Outokumpu Co.
Hakapaa, Erkki A.
Heikinen, Timo Henrik

FRANCE

ERMONT

No Data Supplied
Constantin, Gaston

FOUNTAINBLEAU

Preparation Industrielle
Des Comb.
Quinchon, Francis J.
No Data Supplied
Mohier, L.

HAUTE GARRONE

No Data Supplied
Durand, Jules A.

HYERES

No Data Supplied
Aubert, H. P.

LOIRE

No Data Supplied
Carbonnier, Robt. H.

MEURTHE ET MOSELLE

Lorraine-Ecaut
Guinard, Pierre

MOSELLE

IRSID

Astier, Jacques
Emery, Pierre

MULHOUSE

Mines Domaniales De
Pot. D'Alsace
Callais, Pierre

NANCY

Univ. of Nancy
Roubault, Marcel

NEUILLY SUR SEINE

No Data Supplied
*Walter, Jacques

NIMES

No Data Supplied
Tchintcharadze, J. M.

NORD

No Data Supplied
Brasseur, F.

PARIS

Bauxites Du Midi
Eichenberger, J. Y.
Bureau De Recherches Geol.
*Dufranc, Jean
C. A. E. E.
Shine, Jack E.
Comp. Des Friens et Sign
Trystram, Emile
Comp. Royale Asturienne
Des Mines
Juillet, Jean
Denainmarin
Damien, Rene
Iron Ore Mines Owners Assoc.
Thibault, J. F.
L'Ecole Centrale Des Arts &
Manuf.
*Armanet, Jean Charles
Le Nickel
Thorneysen, C. G.
Lindqvist et Cie
Lindqvist, Olof V.
Mineras & Metaux
*Gy, Pierre M.
Testut, Roger J.
Mobil Oil Francaise
Hazen, George H.
Soc. De Tech. Ind.
Fetit, Daniel
Soc. Min. et Met. De Penarr
Pagesy, Henry J.
Rey, Maurice

Peru-Germany

Sagui

*Coche, Lucien
Union of the French Oversea
Mines
*Belanger, A. J.
No Data Supplied
Bergeaud, F. J.
Blondel, F.
Camplo, Jean
De Choubersky, A.
Destomieux, F. V.
Douglas, James
Kimball, R. H., Jr.
Sainderichin, N. A.
Trumphy, Daniel

SEINE

No Data Supplied
Bodu, Robert

ST. GERMAIN-EN-LAYE

IRSID

Allard, Marc

SEINE ET OISE

No Data Supplied
Mablie, J.

ROQUEBRUNE-CAP-MARTIN

No Data Supplied
Burr, George H.

GERMANY

AACHEN

Tech. Hochschule
Gotte, A.

AMERICAN ZONE

Stahl Sche, Dolo & Lim. Fan.
*Stahl, Wilhelm

BERLIN-STEGLITZ

No Data Supplied
*Kohler, K. Martin

BOCHUM-STIEPEL

No Data Supplied
Wesemann, Heinz F.

BRITISH ZONE

Hannover Kirchrode
Reuleaux, Otto

CLAUSTHAL-ZELLERFELD

No Data Supplied
Schrantz, Hubert W.

ESSEN

Kiesenhau Essen GmbH
*Wasmuth, Roland

FRANKFORT/MAIN

Metalgesellschaft A. G.
Petersen, Cord
Farbwerke Hoechst
Erberich, Gunter

GELSENKIRCHEN

No Data Supplied
Hoevels, C. W.

HAGEN

No Data Supplied
Wilde, H. R. W.

LEUBECK

No Data Supplied
Mantel, H. G.

MAINZ

Mineralogisches Inst.
*Heike, Adolf

MARBURG

No Data Supplied
Neeb, Hans

MURNAU

No Data Supplied
Yomtov, Joseph

Germany-Norway**WALDSASSEN**

Bayerland GmbH
*Spross, Werner

RECKLINGHAUSEN

Bergbau-Ag
*Oberschuir, Max

GREAT BRITAIN**ENGLAND****ABINGDON**

No Data Supplied
Patching, S. W. F.

AYLESBURY

Central Research Lab.
Hacking, Richard A.

BIRMINGHAM

Mining, Mechanical
Metallurgical
Smart, R. C.
No Data Supplied
Brooks, S. D.

BLACKBURN

Houseman & Thompson Ltd.
Lowe, W. H.

BORO GREEN

No Data Supplied
McDermott, E. D.

CHESTERFIELD

No Data Supplied
Doris, George L.

CHICHESTER

No Data Supplied
Lindsay, Lionel

CORBRIDGE

No Data Supplied
Nimmo, James A.

CROYDON

No Data Supplied
Hirst, Tom
Stokes, R. P.

ESSEX

No Data Supplied
Lavers, H. A.

EDENBRIDGE

British Geco Engr. Co. Ltd.
*Callow, Michael J.

GODSTONE

No Data Supplied
Egerton, R. H. L.

GLOUCESTERSHIRE

Dowty Mining Equipment Ltd.
*Cooper, Peter Henry

GREENFORD

No Data Supplied
Middup, Cyril G.

HARWELL

No Data Supplied
Collins, Douglas Neil

KESTON

Seismograph Serv. Ltd.
Van Der Linden, E.

KINGSTON ON THAMES

No Data Supplied
Daniel, Joseph A.

LONDON

Abbey Minerals
*Eldridge, Alan
B. I. S. C. Ore Ltd.
*Percival, F. G.
British Iron & Steel Res. Assoc.
Goodeve, Sir Charles

Campbird Ltd.

Beaumont, Peter
Norman, C. Maxwell
Cent. Prov. Manganese Ore
Co. Ltd.

Hardy, W. A.
Colonial Dev. Corp.

Cochran, H. A.
Float Ore Ltd.

*Wrobel, S. A.
Ham River Grit Co. Ltd.

*Howe, Alan
Imperial College

*Pryor, Edmund J.
Inst. of Polish Engrs.

Dziensiewicz, J.
Inst. of Mining & Metallurgy

Kerrigan, B. W.
Morrison, K. C. B.

Richardson, John B.
Internal Combustion Ltd.

Farrant, J. C.
Intl. Min. & Chem. Ltd.

Bradley, William T.
Mackay & Schnellmann

*Schnellmann, G. A.
Mackenzie Engrs. Ltd.

Schaber, Carl F.
Mason & Barry

Skelmersdale, Lord
National Coal Board

*Collins, Henry Edward
King, Henry R.

*Klempner, Paul
New Cons. Gold Fields Ltd.

Dron, R. W. N.
Ore Sales & Service

White, N. C.
Powell & Duffryn Tech.

Serv. Ltd.
*Dinsdale, J. R. C.

*Masterton, William F.
Royal School of Mines

*Fleming, Marston G.
Garnett, Richard Herbert

Train
*Mellgren, Olav

*Ottley, Derek John
Owen, D. B.

Singh Vig, Mohan
Sierra Leone Dev. Co. Ltd.

Sandham, John Edmund
Selection Trust Ltd.

Peterson, Robert Maurits
Richardson, C. M.

West African Gold Corp.
Jackson, L. R.

Zinc Corp. Ltd.
Connor, W. Watson

No Data Supplied
*Allan John Caldwell

No Data Supplied
Appleyard, K. C.

Boise, Chas. W.
Bradford, W. H.

Fairbairn, Peter E.
*Gill, Donald

Halle, Edwin L.
Hobson, Geo. V.

Horwood, C. Baring
Hutchinson, Dave

*Jones, W. D.
Selkirk, W.

Soane, A. B.
Stokes, Rupert O.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

*Walter, A. J. Petrie
Warren, Wm M.

SHEFFIELD

No Data Supplied
Statham, J. C. F.

SOUTHSEA

No Data Supplied
Allen, K. L.

STOCKTON ON TEES

Ashmore, Benson, Pease & Co.
Dixon, Allan H.
British Chrome & Chem. Ltd.
Birmingham, A. C. J.

STOKE ON TRENT

No Data Supplied
Mandapaty, A. S.

SUNNINGHILL

No Data Supplied
Higgins, A. Howard

TAUNTON

No Data Supplied
Ford, P. V. G.

TORQUAY

No Data Supplied
Gorvin, Cecil J.

WEDNESBURY

No Data Supplied
Isherwood, R. J.

WEMBLEY

General Electric Co. Ltd.
Jenkins, I. Dr.

SCOTLAND**BONNY BRIDGE**

John G. Stein & Co. Ltd.
*Malcolm, Robert

CUMNOCK

Anglo Austral Mines Ltd.
Jones, A. E.

FORFAR

No Data Supplied
Jones, Charles H.

GLASGOW

Tharsis Sulphur & Copper
Co. Ltd.
*Rutherford, William P.
Wm. Baird & Co. Ltd.
McCosk, And. K.

LOCHWINNOCH

Muirshiel Barytes Co. Ltd.
Cruickshank, Michael James

KIRKCALDY

No Data Supplied
*Napier, Alexander Nicol

NEWCASTLETON

No Data Supplied
Jackson, James

STIRLINGSHIRE

No Data Supplied
Hughes, H. P.

STIRLING

No Data Supplied
Thornycroft, T. A.

WESTLOTHIAN

No Data Supplied
Moore, Robert A.

WALES

Steel Co. of Wales Ltd.
Cartwright, W. F.

PORT TALBOT

Steel Co. of Wales Ltd.
Cartwright, W. F.

HENGOED

S. W. Div. of Natl. Coal Bd.
Lancaster, Robert Claremont

GREECE**ATHENS**

Tech. Univ of Athens
*Danikas, D. Panayotis
*Catrakis, Stavros
Greek Inst. of Geology
Zachos, Kyriacos E.
Hellenic Co. of Chem.
Products & Fert. Ltd.
Moussoulou, Lucas
J. Serpieri & I. Gripari
Van Drunen, William
Silver & Baryte Ores Min. Co.
Eliopoulos, George
No Data Supplied
Anastassaris, A. N.
Apostolidis, N. C.
Barounis, A. N.
Scalistiri, D.
Siotis, George J.
Tsoutrellis, C.

LAURIUM

Compagnie Fran. Des Mines
Du Laurium
Calatzopoulos, John C.

STRATONI-HALKIDIKI

Kassandra Mines Mills
*Koulocheris Anastasios I.

MYCONOS

Mycobar Mining Co. S.A.
Garanis, N.
Martin, Dan Wm.
Presanis, Anargyros John

THESSALONIKE

No Data Supplied
Tsailas, D. P.

HUNGARY**SOPRON**

Tech. University
*Beldizs, Dr., Tibor

ICELAND**REYKJAVIK**

Univ. Research Inst.
Tryggvason, Tomas

ITALY**BOLZANO**

S. T. I. M.
*Zoppis, Renato

CORNIGLIANO

Inst. Siderurgio Finsider
Scortecchi, A.

GENOVA

Ferromin
*Chinaglia, Carlo
Soc. Fin. Sider. Finsider Spa
Carli, Dr., Adriano
Soc. Min. E Metall. Di
Pertusola
*Audiert, Paul
Sitta, Giovanni

MILANO

Istituto Ricerche Breda
*Reggiori, A.
Mineraria Prealpina Spa
Jefferson, D. K.
Montecatini S.A.
Rossi, Giovanni
No Data Supplied
Salomone, Mario

PISA

Inst. Di Geol. Dell Univ.
Dessau, Gabor

ROME

Cons. Nazionale Della Ricerche
*Usani, Luigi

TORINO

Politecnico Di Torino
*Stragiotti, Lello

No Data Supplied
*Debenedetti, Arturo
*Jannello, Emidio

LUXEMBOURG**LUXEMBOURG**

Acieries Rounies De
Bur-Eich-Dud
Schmit, Rene

MONACO**MONTE CARLO**

Joy International S.A.
Golson, George A.
*Jetter, R. P.
Steidle, Edward, Jr.,
Wheeler, H. R.
Zemp, J. C.
No Data Supplied
Christensen, J. A.

NETHERLANDS**AMSTERDAM**

No Data Supplied
Jepsen, Johs. L. B.
Schryver, K.

ARNHEM

Billiton Mij.
*Van Der Graaf, J. B.

DELFT

Univ. of Delft
De Wijs, Henri J.
*Seldenrath, Th. R.
Van Bevervordroe, W.

GELEEN

No Data Supplied
Paulen, A.

THE HAGUE

Billiton Co.
Wijnans, A. M. A.
Oost Borneo Min.
*Van Bouse, P. M.
Sarakeek Goudvelden N. V.
de Haan, Willem
No Data Supplied
Van Gogh, F. A. A.

HUIZEN

No Data Supplied
*van Arkel, Hubertus

ROTTERDAM

N. V. Vulcaan
Koeten, Klaas
Levinson, Robert

ZAANDAM

No Data Supplied
Krenning, W.

NORWAY**BJORNEVATN**

A/S Sydavaranger
Brekke, Ottar
Meyer, Ulf Smith

KIRKENES

No Data Supplied
Braaten, Tormod

LOKKEN VERK

Orkla Grube AB
Okkenhaug, A.

MALM

Fosdalens Bergverks A/S
Amdahl, Thor

MO I RANA

A-S Nord Norge
Jonsson, Ingebrigt

MORANA

A/S Bleikvassli Gruber
*Fangel, Henning

NORLANDSBANEN

Elektromekisk A/S
Engzelius, Johan Gustaf

OSLO

Norges Geol. Undersøkelse
*Paulsen, Arthur O.
A/S Sydvaranger
Johansen, J. Kraft
No Data Supplied
Eriksen, Finn R.
*Erling, Kili
Lund, Worm

SUADA

Electric Furnace Prod. Co.
Reinertsen, K.

SULITJELMA

A/S Sultijelma Gruber
Christoffersen, R.

TRONDHEIM

Norwegian Insto. Tech.
Digre, Marcus
*Hofseth, Arne
Killingdal Grubesciskap
Lange, Johan J.
No Data Supplied
Brackken, H.

PORTUGAL**BEIRA BAIXA**

Beralt Tin & Wolfram Ltd.
Mantell, K. E.
Portuguese Amer. Tin Div. of
Yuba Cons. Ind.
*Robb, Alastair Hamilton

FUNDAO

Minas Da Panasqueira
Turner, J. F.

LISBON

Inst. Superior Tecnico
*Thadeu, Decio
Over-Sea Ministry
Carvalho, Antonio Pires de
No Data Supplied
Garcao, J. C. S.

OFORTO

Faculdade De Engenharia
Cerveira, A. D.

RIO DE MOURA

No Data Supplied
Andringa, Gij Pas

SPAIN**ALMERIA**

No Data Supplied
Steenma, R.

BILBAO

Minas y F.C. de Utrillas, S.A.
Cero, Ramon M.
No Data Supplied
Balzola, Jose

MADRID

Standard Oil Co. N.J.
Cabrera Kabana, Manuel
No Data Supplied
Merlin, Robert
Orti, Carlos

TORRELAVERA

Real Co Asturiana De Mina
Ludena, Julio G.

SWEDEN**BOLIDEN**

Bolidens Gruvaktiebolag
Noren, A. B.

BROMMA

No Data Supplied
Kihlstedt, Per G.

DJURSHOLM

KB Fredrik Mogensen & Co.
*Mogensen, Fredrik

No Data Supplied
Ryd, S. Erik

EDEBY RIPSÅ

No Data Supplied
*von Eckermann, Harry

FALUN

Stora Kopparbergs Bergslags AB
Abenius, Hakan Wilhelm
Boman, Johan Erik
Sjoberg, Sven
No Data Supplied
Rutberg, Karl O.

GOTEBORG**SKF**

Lundgren, Bengt G. S.

KARRGRUVAN

Nordbergs Gruvaktiebolag
Anestua, N. S. R.

MALMBERGET

No Data Supplied
Alin, Ragnar
Fagerberg, Bengt C.

MORGARDSHAMMAR

No Data Supplied
Norman, N. Peter

NACKA

No Data Supplied
Kjelgaard, A. W.

RIDDARHYTTAN

No Data Supplied
Karlen, J. S.

SALA

Sala Maskinfabriks AB
Johanson, Edvin B.

SALSJOE-DUVNES

No Data Supplied
Thomaeus, Ivar

SANDVIKEN

Sandvik Steel Wks. Co.
Angel, Trygve Gustaf

SKELLEFTEA

Skelleftea Tekniska Gym
Rothelius, E. J. A.

SKELLEFTEHAMN

Boliden Mining Co.
Wallden, Sven J.

STOCKHOLM

Bolidens Gruvaktiebolag
Herneryd, Olov F.
Schwartz, Sven Gustaf
Grangesberg Co.
Hjortzberg-Nordlund, B.
A. Johnson & Co.
Dalhammar, Sven A.
Kungl. Tekniska Hogskolan
Weberg, F. Martin
L.K.A.B.
Berggren, Olof
Lundberg Expl. Ltd. AB
*Dahlstrom, Elis
Royal Inst. of Tech.
*Janelid, Ingvar
Svenska Diamantberg
Wallin, Karl G.
Sveriges Geol. Undersokning
Henriksen, Svend E.
Swedish Assn. of Engrs.
Akerman, O. M. J.
No Data Supplied
Hedstrom, Helmer
*Svanholm, John W.

STRASSA

Trafik AB Grangesberg-
Oxelund
Lundin, Bror-Knut

YXSJOBERG

AB Yxsjo Gruvor
*Berglund, Lars E.

SWITZERLAND**GENEVA**

No Data Supplied
De B Remy, Marc E.
Hilderbrand, H. H.
Siegfried, W.

MUNUSIO-TICINO

No Data Supplied
*Gutacker, Wilhelm-Bruno

NEUHAUSEN AM RHEINFALL

AIG/Forschungs Institut
Bloch, Dr. E. A.

YUGOSLAVIA**BEOGRAD**

No Data Supplied
Gluscevic, A. Branko

SISAK

Iron & Steel Wks.
Logomerac, V. G.

AFRICA**BELGIAN CONGO****BUKAVU**

Comite National Du Kivi
Fournier, Clement
Touwakde, Marcel E.

ELIZABETHVILLE

Union Min. Du Haut Katanga
Fortemps, H. R.
Steygers, Louis J. E.
U.S. Govt.
Arundale, Joseph C.
No Data Supplied
Geyers, J.

GOMA

Direction General, M.G.L.
Branconi, Ermanno

JADOTVILLE

No Data Supplied
They, Leon F.
Thoumsin, F. J.

KALIMA

No Data Supplied
Grabowsky, A. I.
Smits, H. A. R.

BRITISH EAST AFRICA**UGANDA**

Kilembe Mines, Ltd.
Langevad, Eric J.
Sukulu Mines, Ltd.
Robinson, A. J.

BRITISH WEST AFRICA**BATHURST GAMBIA**

Gambian Min. Ltd.
Thomas, Ronald

EGYPT**CAIRO**

Egyptian Color Factory
Nassim, Ramses L.
No Data Supplied
El Alfay, Edward M.

KIFT

El Sid Gold Mines
Neubauer, W.

FRENCH EQUATORIAL AFRICA**BERBERATI**

Comp. Min. De L'Oubani
Devienne, L.

DAKAR

Senegal Phosphates
Spada, Mario

M'FOUATI PAR LOUET

Comp. Min. Du Congo
Haerten, G. C.

FRENCH WEST AFRICA**CONAKRY**

Bauxites Du Midi
Burki, Axel

DAHOMY

Service des Mines
*Escande, Edilbert

GHANA**ABOSO**

No Data Supplied
Wardrop, J. G.

AKWATIA

Consolidated African Selection
Trust Ltd.
Williams, Edward K.

KIRI

No Data Supplied
Griffiths, M. A.

NSUTA WASSAW

No Data Supplied
Bolsover, James C.

OBUSI

A.C.C. Ltd.
Watson, John L.

KENYA**KISUMU**

MacAlder Nyanza Mine
Stansmore, M. F.

NAIROBI

Maize Control
Stott, George E.
Williamson Diamonds Ltd.
Currie, J. M.
Mines & Geol. Dept.
Kenya Govt.
Horne, William P.
No Data Supplied
Furst, J.
Poussin, Jean M.

LIBERIA**MONROVIA**

Mine Mgmt. Co.
Erickson, Floyd W.
Platt, Philip L.
Bureau of Mines & Geol.
Massaoui, A. M.
Sherman, Arthur

LIBYA**TRIPOLI**

Oasis Oil Co. of Libya
Lager, Albert F.
Amer. Overseas Petr., Ltd.
McRae, Otis M.

MOROCCO**CASABLANCA**

Penn Arroya-Maroc
Audisio, Francesco
No Data Supplied
Savin, Robert

TANGIER

Columbia & Eastern Corp.
*Foster, Richard K.

TOUITSIT

Cie Asturienne des Mines
Gregoire, Eugene

Norway-Southern Rhodesia**ZELLIDJA**

Soc. Des Mines de Zellidja
Altortier, Jean-Pierre
Buliet, Alain
Chlique, Daniel
Livermore, J. S.
Paulhac, J. Jean
Pellerin, Jean F.
Ste. Nord Africaine Dupio
Young, F.

NIGERIA**JOS**

The Jantar Nigeria Co., Ltd.
Thomson, James A.
White, Jack
Nigeria Dept. of Mines
Coakley, P. D.
Ndulue, James A.
No Data Supplied
Ogburagu, I.

KADUNA

Geol. Survey Dept.
Jones, Meurig P.

NORTHERN RHODESIA**BANCROFT**

Bancroft Mines Ltd.
*Barlin, Bernard
Sergiades, F. R.

BROKEN HILL

Rhodesia Broken Hill
Dev., Co.
Douglas, W. B.

CHINGOLA

Nchanga Mine Chingola
Egelseer, C. H.
No Data Supplied
Page, Eric W.

KALUSHI

R.S.T. Mine Services, Ltd.
Norrie, James P.

KITWE

Rhoanglo Mine Services, Ltd.
Fitzgerald, M. L.
Young, E. C.
Rhokana Corp. Ltd.
MacLeod, Donald
No Data Supplied
Martineovic, N.

LIVINGSTONE

Frobisher Ltd.
Pretorius, D. A.

MUFULIRA

Mufulira Copper Mines Ltd.
O'Connell, C. A.
Young, David
No Data Supplied
Gilmour, Norman T.

MUMBWA

No Data Supplied
Brooks, Raymond

N'DOLA

Dept. of Mines
Baillie, J. E.

PORTUGUESE WEST AFRICA**ANGOLA**

Comp. Mineira De Lobito
De Sousa Machado, F. J.
No Data Supplied
Flores, F. D. A.
Vieira, H.

SOUTHERN RHODESIA**BULAWAYO**

E. L. Bateman Pty., Ltd.
Mills, Arnold
Frobisher, Ltd.
Standers, J. R.
No Data Supplied
Anderson, Robt. B.
Coolbaugh, John

Southern Rhodesia-India**FORT VICTORIA**

No Data Supplied
Barker, Henry T.

GWANDA

No Data Supplied
Chalmers, A. F.

GWELO

Govt. Mines Dept.
Davey, Bernard

MAZOE

No Data Supplied
Christie, Jack

SALISBURY

Anglo Amer. Corp.
Heath, K. C. G.
Taylor, H. H.
Atlas Copco Eastern, Inc.
Wallenberg, Peter
Rhodesian Selection Trust, Ltd.
Bierling, J.
Prain, Sir Ronald L.
No Data Supplied
Guernsey, Tarrant D.

SINOIA

No Data Supplied
Ewing, J. R.

SOUTH WEST AFRICA**TSUMEB**

Tsumeb, Corp.
Boyce, J. Howard
Down, R. F.
*Du Toit, P. J. G.
*Gevers, R.
Rambosch, A. F.
Ratledge, J. P.
Reid, T. L.
Stott, Charles E.
Venter, Wessel J. C.
No Data Supplied
Bock, P.
Benedict, P. C.

TANGANYIKA**MBEYA**

Mbeya Exploration Co.
Van Cruyningen, J. P.

MPANDA

Uruwira Minerals, Ltd.
Harrison, K. W.
*Mead, William E.

MWADUI

Williamson Diamonds, Ltd.
Hunt, G. F.

TABORA

Uruwira Minerals, Ltd.
Whiten, Kevin J.

TOGOLAND**MANGO**

No Data Supplied
Gravillou, A. L.

TUNIS**TUNISIA**

Comp. Royale Asturienne
Des Mines
Mothers, Bernard

**UNION OF
SOUTH AFRICA****BLYVOORUITSIG**

No Data Supplied
Mellish, M.

CARLETONVILLE

No Data Supplied
Clee, R. A. Sesink
Collard, John S.
Fisher, Roger C.
Von Muller, M. J.

**CLAREMONT CAPE
PROVIDENCE**

No Data Supplied
Amdurer, Stan S.

COALVILLE

Tweefontein United Coll.
Lee, R. A.

JOHANNESBURG

African Surveys Pty., Ltd.
*Webster, Jack C.
Amer. Consulate
Bramson, Bernard Allen
Anglo Amer. Corp. of S.A. Ltd.
Waters, Arnold E., Jr.
Ed. L. Bateman Pty., Ltd.
Bateman, Glen L.
Diamond Research Lab.
Linari-Linholm, Dr. A. A.
Elmco S. A., Pty. Ltd.
Summers, H. A.
Fraser & Chalmers, S.A. Ltd.
Duff, Bernard W.
Stansmore, Norman
H. H. Fraser & Assoc., Pty.
Fraser, H. H.
Gypsum Industries, Ltd.
Fockema, Rudolph A. P.
Jeffrey-Gallion, Pty., Ltd.
Wilkes, Albert Edward
Johannesburg Cons. Inv. Co.
Westwood, R. J.
Joy-Sullivan (Africa) Pty., Ltd.
Hadfield, Herbert C.
Walker, Frank James
New Union Goldfields, Ltd.
Gillfillan, A. E.
Otavi Mining Co., Ltd.
*Sommerlatte, Dr. H. W. A.
Rand Mines, Ltd.
Fraser, Alistair E.
So. African Cyanamid, Pty.
Dykhouse, B. S.
Oosthuizen, E. D.
Wildner, Glenn S.
U.S. Atomic Energy Comm.
Eberth, W. F.
Univ. of Witwatersrand
Mendelssohn, Edgar
Morris, Hugh C.
No Data Supplied
Dixon, I. W.
Hultquist, Carl E.
Ortlepp, J. A. L.
Prentice, Thomas K.
Retelbey, H. F. W.
Van Der Merwe, O. T.
Veitch, N. A.
Von Maltitz, A. A.
Wartenweiler, Fred
Weiss, Oscar

KIMBERLEY

De Beers Cons. Mines
Gallagher, W. S.

KINROSS

Winkelhaak Mines
Dall, A. E.

LIBANON

Libanon G. M. Co.
Taylor, J. Philip

MANGULA

MDT Mangula, Ltd.
Hattings, A. M.

MANAQALAND

No Data Supplied
Vose, James H., Jr.

MESSINA

Messina Trans. Dev. Co., Ltd.
Hall, W. B.
Messina Tvl. Dev. Co., Ltd.
Spence, W. I.

MARAISBURG

No Data Supplied
Margo, Eli

MOOKETSI

Klein Letaba Mining Co.
Oltman, Robert E.

NATAL

Umgababa Min., Ltd.
Jackson, Ernest J.

OI OKIEP CAPE PROVINCE

Oi Okiep Copper Co., Ltd.
Byrd, R. C.
Chamberlain, Clair C.
De Beer, J.
Ferguson, John M.
Hunt, E. W.
MacLeod, J. M.
Pearce, D. O.
Smyth, James H.

OLIFANTSFONTEIN

Cullinan Refractories, Ltd.
Bradley, Alan L.
*Preller, G. S.

PHALABORWA

Phosphate Dev. Corp., Ltd.
Smit, J. S.

POSTMASBURG

Mancorp. Mine
Brownrigg, S. R.

PRETORIA

So. African Iron & Steel
Industrial Corp.
Alberts, Barend C.
U.S. Embassy
La Tendresse, H. E.
No Data Supplied
Hoffman, D. J. N.
Krahmann, Rudolph

SABIE

No Data Supplied
Hossy, Ian H.

SILENT VALLEY

No Data Supplied
Brown, S. R.

SPRINGS

Grootvlei Prop. Mines, Ltd.
Mokken, A. H.
Union Corp.
Reysenbach, J.

STILFONTEIN

Hartebeestfontein Gold Min.
Co., Ltd.
De Kok, S. K.

SUREBEKOM

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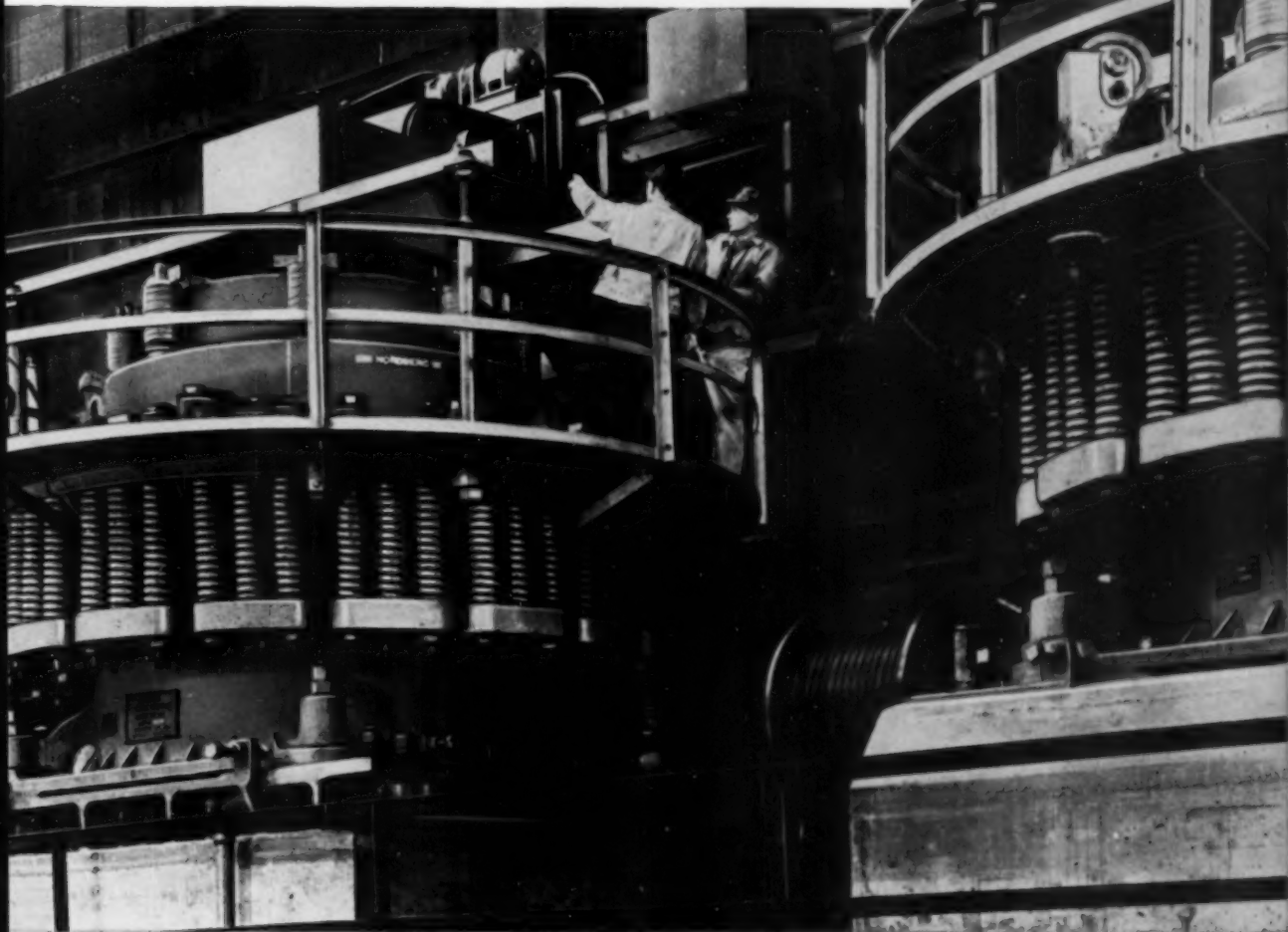
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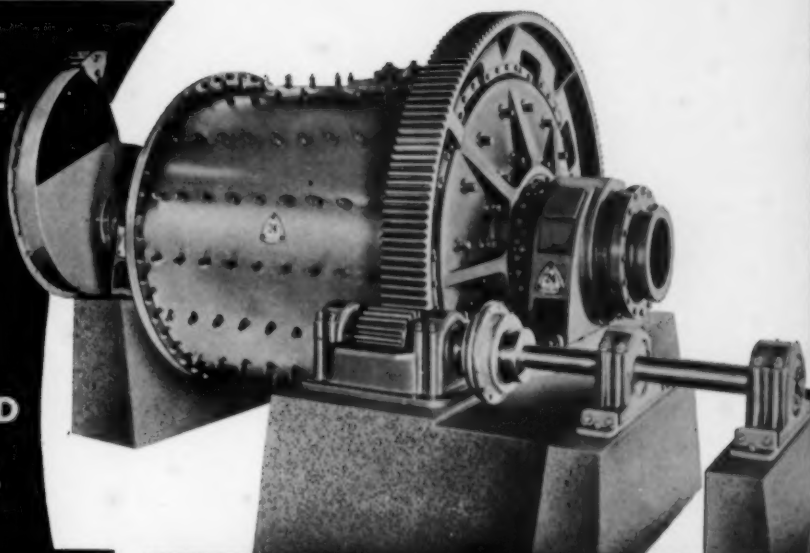
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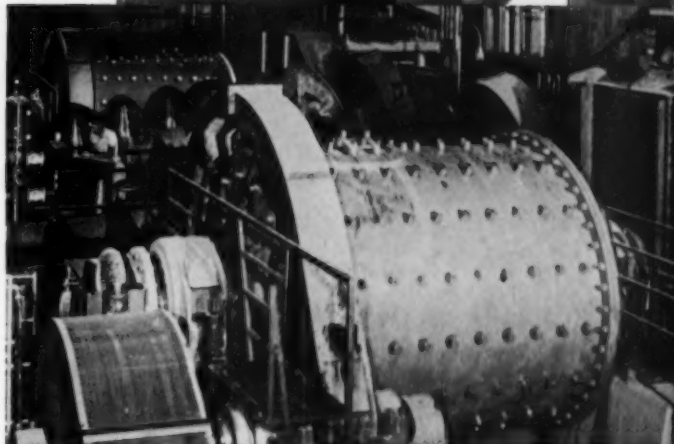
Steel Head

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in **GRINDING MILL**
SELECTION



All Big DENVER Ball Mills Have These Distinctive Design and Construction Features Important to the Productivity and Profitability of Your Grinding Operation:

- **Cast Steel Heads** many times stronger than cast iron. Eliminates risk of head breakage.
- **Ball and Socket Trunnion Bearings** are sealed to exclude dirt and dust.
- **Continuous Lubrication** from oil reservoir in trunnion base.
- **Hydraulic Lift Mechanism** takes load off trunnion bearings for easy starting. (optional)
- **Adjusting Sole Plate** under trunnion bearing base is bolted to one-piece pinion shaft bearing housing—assures perfect, permanent alignment of gear and pinion—for trouble-free operation.
- **Self Aligning, Anti-friction Pinion Bearings** are in cart-ridge type carriers and mounted in a one-piece housing.
- **Greater Capacity**—both diameter and length are measured inside liners.
- **Choice of 15 Types of Mill Discharges** to meet individual grinding requirements.



Eliminate Risk — Be Sure! Use . . . DENVER GRINDING TEST SERVICE

DENVER'S completely equipped testing lab is backed by over 30 years of practical test and field experience. Complete facilities for batch or pilot tests, open and closed circuit grinding, wet or dry, 2-stage systems with mechanical cyclone, screen or air classification. Determine grinding characteristics, mill capacities, circulating load, size of accessory equipment, power requirements. Preliminary examinations made without charge.

For Complete Information Write for Bulletin B2-B20



DENVER EQUIPMENT COMPANY

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Complete Mill Equipment





NEW M-S-A® PERMISSIBLE MINE LIGHTING SYSTEMS PROMISE GREATER PRODUCTIVITY AND FEWER ACCIDENTS FOR MINES



Here's significant news for the mining industry: the new M-S-A Permissible Mine Lighting Systems will provide working crews with the first *safe* units for underground illumination since the electric cap lamp.

These systems provide supplementary illumination to electric cap lamps, principally in working areas, to make operation safer and more efficient. They are available in isolated ungrounded two wire and grounded three wire circuits.

Key to the systems is the M-S-A Fluorescent Lamp Fixture. This portable unit utilizes two 14 watt fluorescent tubes and operates from 230 volts, 60 cycles. Also available for operation from 115 volts, 60 cycles. Write for descriptive bulletin.

MINE SAFETY APPLIANCES COMPANY

301 North Brodbeck Avenue, Pittsburgh 8, Pennsylvania

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